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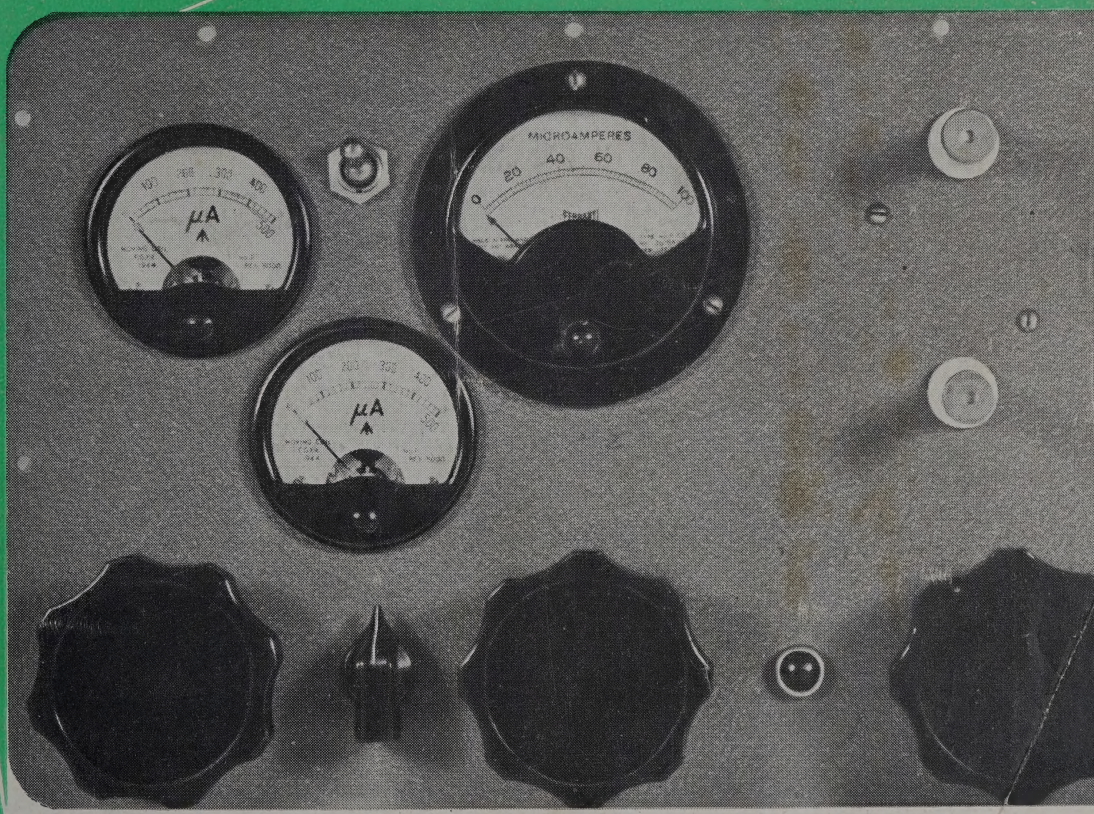

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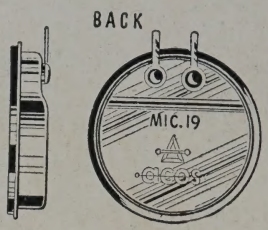

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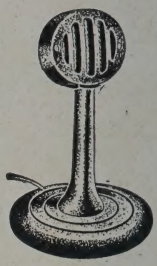

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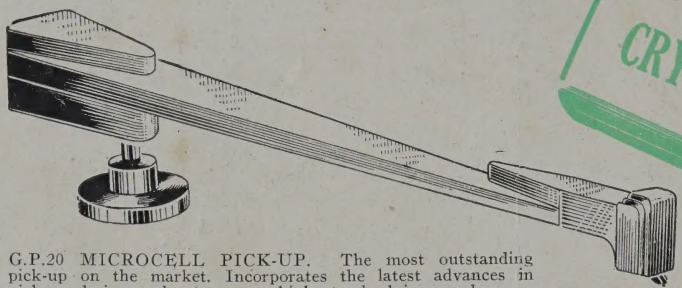

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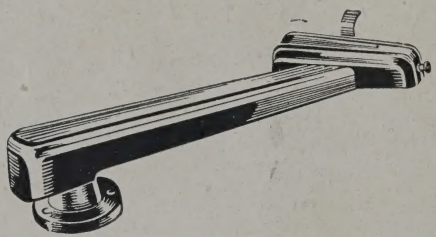

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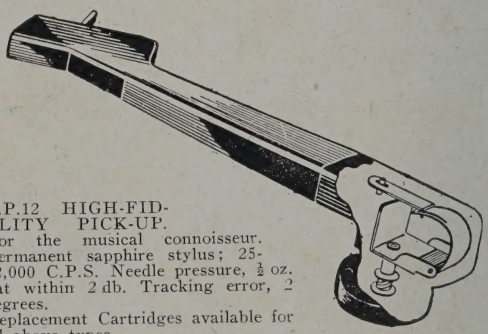

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OUR COVER

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THINGS HAVE CHANGED

In a recent issue of the British magazine *Wireless World,* is a short paragraph which draws attention to the late Lord Derby, and the fact that as Postmaster-General, in the year 1904, he was responsible for setting a precedent for which amateur transmitters throughout the Empire should be eternally grateful. The occasion was the passing by the House of Commons of the first Wireless Telegraphy Bill, and the noble lord's words during his second reading speech are worth quoting: "The class with whom I have the greatest sympathy," he said, "are those who wish to go in for experiments in this science, and I have been able to frame a clause which will give absolute freedom in that direction, merely requiring registration on the part of those who wish to engage in experiments. In a matter of this description the House will doubtless desire that the Act should be administered as liberally as possible, and I shall certainly do my best in that direction. For what it is worth I will give an undertaking that no request for a licence for experiments shall be refused unless the refusal has been approved by me personally."

These words might well be termed the Magna Carta of the amateur transmitter. Needless to say, the original delightfully simple state of affairs has not been retained, but it is important to note that the principle has not changed at all. The additional restrictions that have been placed on amateur activities have perhaps been regrettable, and no doubt call forth some nostalgic sighs from many "Hams" whose memories are not even as long as 1904, but the fact remains that they have been essential, in a world where radio communication has become such a vital service that every available kilocycle of the spectrum is needed. We are prone in these times to bemoan every additional restriction in an ever more regimented world, but the fact remains that wtih the frequency requirements of the nations so vast, amateurs are lucky to have any space left to them at all. Let it not be inferred that this journal does not believe that amateurs are worthy of every consideration. In the past, amateurs have rendered very great service to the nation, both in peace and in war, and it would be a very unjust thing if amateur activity were to be prevented because of restrictive legislation. On the other hand, amateurs should not forget that they possess their present frequency bands by way of privilege, and not as of right, and that given the appropriate conditions, they can be put off the air by legislation, as surely as they occupy their present privileged position by virtue of other legislation. In time of war, amateur radio has to be suspended for a number of reasons, and it should be the constant concern of organized amateurs to see that their members themselves give no cause for peace-time restriction of their own privileges.

There is a large body of amateurs whose interest in transmitting is not technical, but centres rather round the making of conversation with other amateurs, and forming "over the air" friendships. No one would say that those who go in for this sort of amateur activity should be discouraged. Indeed such a recommendation would be highly undemocratic. But some of these "talkers," as we may call them for want of a better term, are anything but an ornament to amateur radio. Their conversation and operating practice is on the air for all to hear, and many non-amateurs with all-wave domestic sets do listen to the amateur bands. It follows, therefore, that the "talkers" are those among the "ham" fraternity whose activity comes most before the public view, if only for the reason that they spend more time on the air than many whose interests are elsewhere. Unfortunately, however, some of the worst operating practice comes from among their ranks, and some of it sounds fairly dreadful even to other amateurs, let alone to the general public. Again, the "talkers" are prone to long spells at the microphone, very often with quality of transmission that leaves a good deal to be desired. This sort of thing does not make them popular with other amateurs, particularly when the bands are so crowded, and it is quite understandable when in consequence. they are taken to task in the amateur literature for their lack of consideration for other users of the bands.

Even a casual search round the 80-metre band these days gives one cause to reflect that amateur radio is not what it was. At one time, the people who came on the air and talked about anything but radio were fairly few and far between, because the main bond between amateurs was their common technical interest. Much of the tecnical talk that used to be heard was ill-informed, but almost all of it was characterized by an obvious desire to learn, and those amateurs whose technical knowledge was rather greater than the average were keenly sought after by the less knowledgeable. This sort of thing seems to us to be much nearer to the kind of amateur whom Lord Derby had in mind when he framed his 1904 legislation. He could not have foreseen the "talkers," aforesaid, and the point we wish to make here is that he might have been horrified if he had been able to!

The moral of all this is that those responsible for controlling amateur radio by the granting of licences, and the administration and framing of amateur regulation do not have to foresee anything of the kind, because it is there for the hearing, and if a sufficiently large number of people among those in authority should decide that any section of radio amateurs is sufficiently little of an ornament not to be considered useful, it is not a long step to the restriction of amateur radio privileges, and not necessarily in a way that can be ascribed to the exigencies of ether space.

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TELEVISION IN THE NEWS

Early last month, about the only topic of conversation among radio men in Wellington was the demonstration of wired television put on in that city by Amalgamated Wireless Australasia, Ltd., in conjunction with the New Zealand Broadcasting Service. The demonstrations were relatively few in number, extending over only four days, so that it was not possible to issue invitations to the public at large, and a large number of would-be viewers were unfortunately disappointed. *Radio and Electronics* was particularly fortunate, therefore, in being invited to inspect the equipment just after it had been set up, and before the demonstrations proper took place.

Unfortunately, the writer was unable to attend the official demonstrations, through being away at the time, but to be present while the gear was being set up, and to inspect it closely, was of considerably greater interest to a technical man than the mere sight of programme-material on the receiving screens. The equipment used was a standard set of outside-broadcast picture-generating gear, and included its own waveform generating circuits. The camera used the latest type of image orthicon, whose sensitivity is amazing, and which enables scenes to be picked up in no stronger light than the eye itself needs to see in. The tube was used in conjunction with a battery of four lenses in a turret, arranged so that any lens could be switched into action in a few seconds. This optical arrangement makes it possible to view a scene from as many different points of view as there are lenses, without moving the camera at all, and alters the field of view from extremely wide-angle to that of a telephoto lens, with two intermediate steps.

The pictures were displayed on five "receivers" which had been put together in the A.W.A. laboratories for the purpose. Four of them used 10 in. viewing tubes with aluminized screens, while the fifth had a 16 in. screen, non-aluminized. The equipment itself, of course, has monitor tubes built into it. One is on the camera itself, and acts as the view finder. In fact, there is no optical view finder at all. This tube is quite small, and showed a picture no more than four inches wide. In the control gear, remote from the camera itself, was another monitor tube giving a picture about six inches wide. The latter was the first one on which the writer saw pictures, and it is a noteworthy fact that the quality of this picture was *better* than that on any of the demonstration units, in spite of the larger tubes which they employed.

THE CAMERA TUBE

Apropos of the camera tubes, these were stated to cost approximately $1300, and to have a first,class life of some 300 hours only. This does not mean that after this length of time they cease to function. What happens is that the sensitivity and definition commences to fall off slowly and imperceptibly, so that after this time, on the average, the tube was not reckoned able to give a performance representative of the best of its type. The construction of the camera tubes is almost incredibly complex, and after hearing a little about their construction, the wonder is that they do not cost twice as much as they do, when the enormous developmental effort that must have gone into them is considered. For instance, the photo-cathode is a transparent deposit (only a few molecules thick) on an exceedingly thin piece of glass of a special type. The cathode gives off photo-emissive electrons, which are accelerated towards the storage screen by an annular accelerating electrode, some 500 volts positive with respect to the cathode. There must clearly be some means by which the electrons emitted by the photo-cathode may be recovered, otherwise the latter would acquire a permanent positive charge, which would spoil the action of the accelerator, and make emission more difficult. The method used to restore the cathode to an uncharged state is to make the glass in which it is mounted, of a specified insulation resistance, so that the leakage through it takes place at just the required rate. This is only one of the many technical details that must have meant tremendous quantities of work and investigation before they were solved satisfactorily.. The target plate, on which the electrons from the photo-cathode impinge after acceleration, is a mesh containing minute holes at a density of hundreds of thousands to the square inch—surely in itself a rather ticklish manufacturing problem?

PICTURE QUALITY

The first reaction to the quality of the picture was "That's better than my 8 mm. movie outfit," and closer and longer observation did nothing to alter this opinion. The same thing could by no means be said for the pictures on the demonstration screens, however. This criticism was not on the score of resolution, however, but on that of non-linearity. Many of those who saw the official demonstrations have since remarked on this non-linearity —technical and non-technical people alike, since it was bad enough to be observable in such things as the shape of a face. The detail was certainly of a very high order, as was to be expected of a system which did not include tranmission over the air and subsequent radio frequency amplification and detection in the receiver. Perhaps the most impressive demonstration of the capabilities of the whole system—electronic and optical—was the first scene the writer saw. It was in the morning, and the camera was aimed out the studio window down Featherston Street, at two men talking on a street corner. There was nothing very remarkable about the received picture, except that the detail was as good as one could wish for; the figures of the men were shown about three-quarter length, and the match with which one of the unwitting actors lit his cigarette could almost be seen—the cigarette itself certainly could. The shock came on looking out the window to see how the "live" scene compared with the reproduced one, when it was discovered that the street corner on which the men were standing was about two hundred yards down the road! What better could be wished for, for televising such things as cricket or football matches? It seemed as if a cricket or tennis ball would be the easiest of objects to show, even at a great distance, but in this, of course, we might have been over-estimating the capabilities of the system.

One of the engineers in the party that was operating the equipment said that the picture was using about 400 active lines. This seems rather on the low side for a system with a total of 625 lines, but unfortunately, everybody was so busy that there was little opportunity to inquire further. The R.M.A. test chart showed that the horizontal resolution, which depends on the video bandwidth used, was of the same order, but at the time, the best demonstration camera tube was not in use, since the apparatus was being adjusted and tested with a tube whose best days were past.

SOME PROPAGANDA?

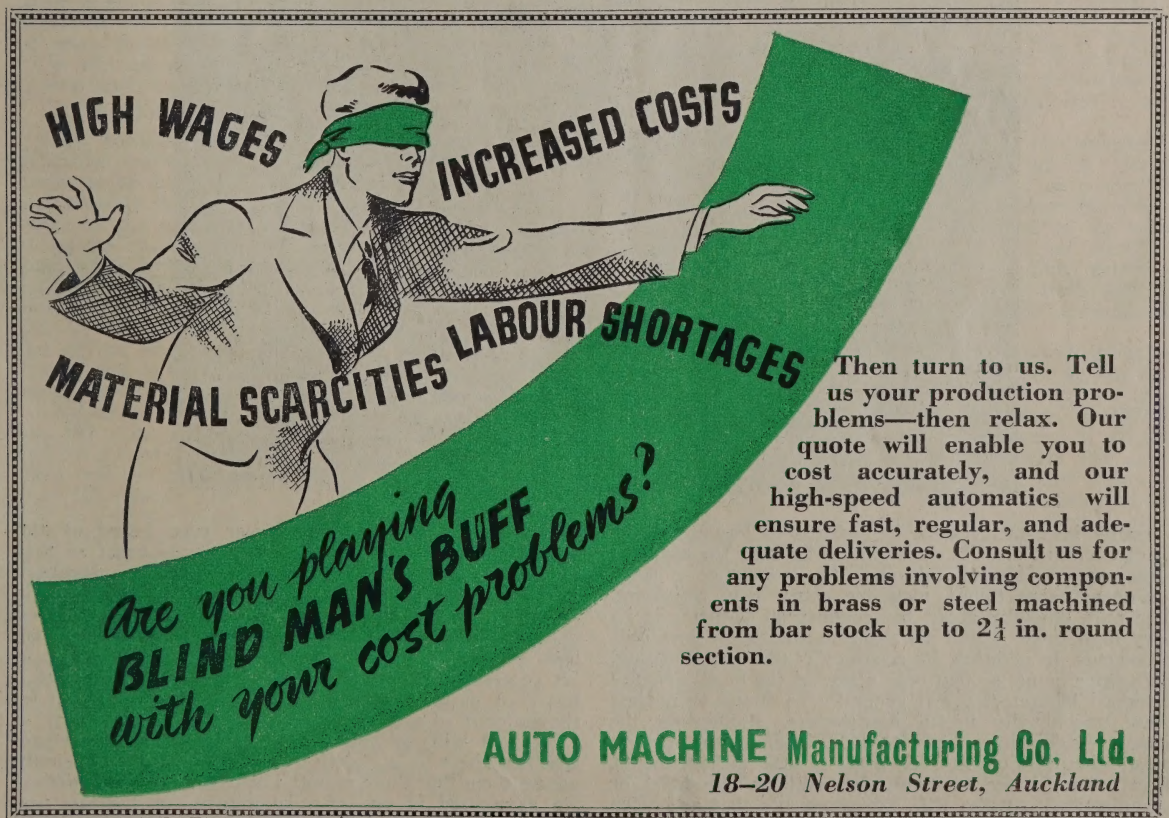
The fact that the demonstration equipment was 625 line, in accordance with the standards decided upon for Australia recently, does not necessarily mean that we shall have the same standards when TV actually comes to these shores. It was noted, however, that Mr. Hedley

Bryant, the publicity officer of the A.W.A. party was most insistent about the advantages of 625 as against any other line number that could be thought of. It would certainly be very convenient if New Zealand were to settle for the same standard specification as the Australian one, but Mr. Bryant did not altogether succeed in making out a case for 625. When asked, did he not think that there were certain disadvantages in the 625 figure, he would not even admit that it would increase the cost of receivers—a cost that is bound to be high in any case—but stated that post-war developments have made the cost of a 625-line system no greater than that of a 405-line system. It was noted, too, that he made similar statements in interviews with the daily press, and that in one of them, he is credited with the utterly misleading statement that 625-line pictures necessarily give better definition than systems with fewer lines. It seems a pity that TV in New Zealand should have got off to a start that appears to be somewhat concerned with what might be termed the "commercial politics" of the subject, and not exclusively with what might be best from the consumer's point of view, viz., the TV screen!

It has always seemed regrettable to the writer that such a technical misapprehension should exist even among well-informed people, but it is even worse to find a technical half-truth being used in a misleading manner apparently for commercial purposes.

The fact is that 625 lines will not *necessarily* give a better image than 525, 405, or any other number. It *is capable* of so doing—of that there is no doubt—but whether it will or not depends on other factors. It is quite well established that unless bandwidth is increased, in step, as it were, with any increase in the number of scanning lines, the quality of the picture is actually worsened by the mere increase in the number of lines. And increased bandwidth costs money. So from whatever way it is regarded, there is no justification for hailing any system as technically superior just because it has more lines. The question of the line standard to be adopted here is a sufficiently vexed question without the addition to it of commercial politics, and it is to be hoped that those responsible will not be swayed by such considerations when the time comes to make a decision.

However this may be, there is no doubt that the demonstrations have created very great interest, both among the public at large and among technical men, and that Messrs. A.W.A., and no less the N.Z.B.S., are deserving of our thanks for giving us the opportunity to see for ourselves just how good modern TV pictures are. There is a strange reluctance to take anyone else's opinion in such matters, even with the best will in the world, and it is a very sound move to have given even a small number of laymen a practical idea of just what TV can do. Those responsible are to be congratulated on the demonstrations, and this journal would like to thank them on behalf of the radio industry as a whole for having the foresight and initiative to give them to us.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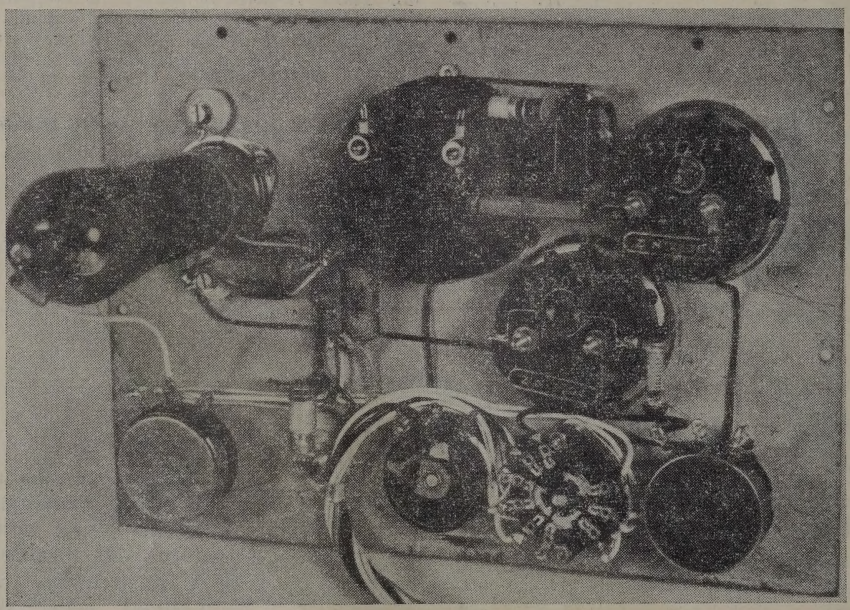
An Easily Constructed Instrument for Measuring R.F. Resistance and Other Important Quantities

Many radio workers, both amateur and professional, frequently have cause to lament the lack of expensive instruments such as the Q-meter, but there is an excellent way of making many of the measurements that the Q-meter can perform at considerably lower cost, and with gear that is readily available. This way is described in the present article, and the construction of suitable gear is outlined also. The equipment would form a useful addition to any laboratory, and yet is within the pocket and the capabilities of most amateurs to build.

INTRODUCTION

The designer, the serviceman, the amateur transmitter and the amateur constructor all feel the need at some time or another, of an instrument which will measure the various quantities associated with radio frequency tuned circuits, and more often than not, are unable to get the measurements they need through non-availability of the necessary equipment. This is due more than anything else to the very high cost of laboratory instruments such as Q-meters, and R.F. bridges. The former is a very versatile instrument, since in addition to measuring the Q of a circuit directly, it is able to be used for accurate measurement of small capacities, the inductance of coils, and many other things, including actual R.F. resistance. The only difficulty about the commercial Q-meter is its very high price, which always runs into some hundreds of pounds. In addition, its accuracy is not very startling, high price or no, so that only a few of the most lavishly-equipped laboratories will generally be found to possess these undoubtedly useful instruments. Somewhat the same considerations apply to R.F. bridges, and also to most other instruments for making R.F. measurements. How, then, is the relatively impecunious individual or organization to make R.F. measurements that are often essential to the work in hand? A common practice is to obtain access to a laboratory which possesses the coveted equipment, but this is never a very satisfactory solution, since it means relying on someone else's generosity, and also entails taking the job to the instrument, instead of vice versa.

It is strange, therefore, to realize that there is a very satisfactory way of making many R.F. measurements with gear that is very simple to construct, and which can be built for less than ten pounds. The strangeness of the situation is even more apparent when it is realized that many radio men have never even heard of the method, and that its scope is at least as great as that of the Q-meter, while for some purposes, its accuracy is *considerably* better. The simplicity of the equipment is almost unrivalled, too, since it consists only of a modified dynatron oscillator. The usefulness of this device has been publicized for many years by M. G. Scroggie, in his successive editions of "Radio Laboratory Handbook," but even so its virtues seem to have blushed unseen by the majority of radio men.



Readers will no doubt wish to know, at this stage, whether there is a "catch" in it, but we can solemnly assure them that there is not. The dynatron is the method we have used in our own laboratory for the last five years for measuring inductance, dynamic impedance, R.F.

resistance, self-capacity, etc., of R.F. circuits, and the completed instrument's front panel is the cover picture for this issue.

WHAT THE DYNATRON MEASURES

The basic measurement that is made by the dynatron oscillator is that of the *dynamic impedance* of parallel-tuned circuits, and not the Q of the circuit, though this is closely related to the dynamic impedance. Actually, the dynamic impedance, or the parallel resistance at resonance, as it may also be described, is in many ways a much more useful thing to measure than the Q. It gives a direct measurement of the gain that can be expected, relative to that of another coil for the same frequency, when either is used in an amplifier stage, and is actually a better "goodness factor" than Q for most purposes. The Q-meter, as its name implies, measures Q directly, but from this and a measurement of inductance, the dynamic impedance can be calculated. In fact, the Q-meter and the dynatron are similar in that each can only make one basic measurement from which, with the aid of one or more additional measurements, other quantities can be evaluated. With the dynatron, the dynamic impedance is measured directly, and with a further measurement of inductance, the Q can be calculated. On this score, then, there is little or nothing to choose between the two, with, if anything, a slight advantage in favour of the dynatron, since it is usually more important to know the dynamic impedance than the Q. With both instruments, the other quantities listed have to be found by calculation from two or more measurements with the instrument itself, or with, say, a capacity bridge. But the latter is not a very expensive item, and is one found in any laboratory, and in many amateur workshops. It can be seen, therefore, that the dynatron is by no means to be sneezed at, since it will do practically all that the tremendously expensive Q-meter can, and just as quickly.

PRINCIPLE OF THE DYNATRON

Most readers will, no doubt, be familiar with the dynatron oscillator, at least in name. It was the first device to be discovered that exhibits negative resistance, and possibly the first two-terminal oscillator circuit. It relies for its operation on a characteristic of the early screen-grid valves that was in the first instance somewhat of a nuisance, and arises because of secondary emission within the valve. Readers will all have seen the plate characteristic curves of such valves as the 224, 235, 32, etc., which were in use as R.F. amplifiers before the advent of the R.F. pentode. Each curve on the family had a shape like the one illustrated in Fig. 1, which can be explained as follows.

Imagine the valve as having its normal screen voltage, say 100 volts, its normal grid bias of, say, —3 volts, and for a start, zero plate voltage. Under these conditions there will be no plate current, since all the electrons from the cathode will be attracted to the screen-grid and will flow in the screen circuit. Now if the plate voltage is gradually increased from zero, a few of the electrons which pass through the mesh of the screen will be attracted to it and a small plate current will flow. At first, the plate current will be approximately proportional to the plate voltage, but soon the plate current starts to rise less rapidly, as is shown by the curve becoming less steep. The reason for this is to be found in the occurrence of secondary emission at the plate. Some of the electrons striking it dislodge other electrons from it. These dislodged, or secondary electrons, either fall back on to the plate, in which case they do not affect the plate current, or else being attracted by the higher positive potential of the screen, travel towards it and land upon it. Electrons which do this increase the screen current, but decrease the plate current, so that this is less than it would have been if secondary emission did not take place. As the plate voltage is increased, so a point is reached where the increase of plate current due to the higher plate voltage exactly equals the decrease due to secondary emission *from* the plate, so that there is no

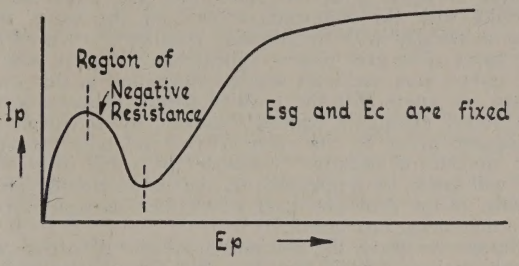


Fig. 1

increase or decrease of plate current as the voltage is altered over a small range. This point is marked by the first vertical dashed line on Fig. 1. As the plate voltage is still further increased, the secondary emission increases *more rapidly* than the normal plate current does, so that the plate current actually decreases as the plate voltage is increased. This is the downward-sloping portion of the curve of Fig. 1, and is the one part of it that we are interested in practically, for this behaviour constitutes *negative resistance*. An ordinary, or positive resistance, is a component in which the current increases as the voltage across it increases. That is to say, it absorbs energy from the voltage source. A negative resistance, on the other hand, is any device in which an increase in voltage across it *decreases* the current through it, and must therefore actually supply energy itself.

Now let us see what would happen if we connected a negative resistance across a tuned circuit. We know what happens if a positive resistance is so connected. It absorbs energy from the circuit, and causes the damping to be increased. A negative resistance, on the other hand, decreases the damping on the circuit, and therefore reduces the energy losses. A high positive resistance connected across a circuit will mean a small *loss* of energy, and in the same way, a high negative resistance will mean a small *addition* of energy.

If we imagine that the value of our negative resistance can be varied at will (and this can be done) an interesting situation arises. Suppose, for example, that we have a tuned circuit whose dynamic impedance is 200,000 ohms, and that we have a negative resistance of 400,000 ohms which we connect across it, in parallel. The question is, what is the resultant actual resistance? Since we know that the connection of negative resistance across the circuit *reduces* the energy losses, the answer *must* be a positive resistance higher in value than the original 200,000 ohms. If we use the ordinary formula for resistances in parallel, but taking account of the *signs* of the resistances, we find that the answer works out to a *positive* resistance of 400k. If now we make the negative resistance smaller—say 300k., the answer for the two in parallel works out to a positive resistance of 600k. But what happens if we make the negative resistance lower still—say 200k.? This time the answer comes to infinity —and this means that there are no losses at all, for an infinite resistance connected across anything cannot introduce any loss. But if we have a tuned circuit in which there are no losses, we know that once started, it will go on oscillating continuously—and this is just what

happens in the dynatron oscillator. The circuit consists of a screen-grid valve in which the screen voltage is higher than the plate voltage, in the right ratio to put us on the negative resistance part of the characteristic. Then we use the control grid bias as a control of the amount of negative resistance. We connect our tuned circuit in series with the plate lead, and therefore in parallel with the plate-cathode path of the valve, and thus in parallel with the negative resistance produced by the valve. The grid bias is adjusted to the point where the circuit just oscillates and no more, and in this condition we know that the positive parallel impedance of the tuned circuit is exactly balanced by the negative resistance given by the valve. If we can now measure the amount of negative resistance the valve is giving, we will know the impedance of the tuned circuit. This, briefly, is the principle upon which the dynatron works as a measuring instrument.

Before we leave the mechanism of the dynatron, we should perhaps explain how it is that the negative resistance characteristic does not persist over the whole range of plate voltage. As the plate voltage is increased, the negative resistance decreases to its minimum value, as shown by the maximum slope of the negative resistance part of the curve, approximately in the middle. However, as the plate becomes more positive, more and more of the secondary electrons are attracted back to the plate, instead of going to the screen, and thus the negative resistance increases again, and at some point disappears altogether. This is the right-hand one marked with the dotted line, so that the circuit displays negative resistance only when the plate voltage lies between the values represented by the dotted lines. In practice, the centre of the negative resistance region is usually in the vicinity of 45 volts, so that we find the valve worked with a plate voltage of this value, and a screen voltage of 90 to 100 volts. The screen voltage should not be higher, because the screen current under some circumstances can become rather large, and damage the valve.

In Fig. 2 is shown a practical circuit for a dynatron oscillator, with battery supplies for plate, screen, and control grid. This circuit is sometimes used as a stable oscillator, and is the basic one from which the detailed circuit of the test instrument is derived, by means of various quite simple additions.

HOW NEGATIVE RESISTANCE IS MEASURED

In order to turn the dynatron oscillator into a measuring instrument, it is necessary, as we have mentioned, to be able to measure the actual negative resistance obtained. There are two main methods of doing this. One makes use of a special bridge circuit, which could be built into the measuring equipment, and the other, known as the *incremental* method, is the one used here. The idea is to make a slight change in the plate voltage, and to measure the change in plate current that results. Alternatively, we can increase the plate voltage until we have a specified decrease in plate current. The increase of the plate voltage is then measured, and the negative resistance is worked out from Ohm's Law in the ordinary way. It is necessary to exercise a certain amount of care when this method is used, because, for the answer to be exact, the plate current and voltage changes would need to be infinitely small. However, as long as the changes are very small—especially that in plate current—there will be no great error involved. In

(Continued on page 27.)

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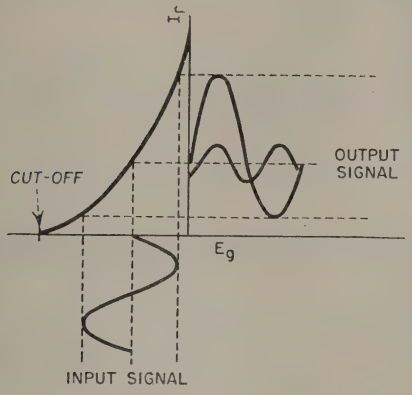
AUDIO FREQUENCY DISTORTION MEASUREMENTS

Part I—Methods of Measurement

By the Engineering Department, Aerovox Corporation

This is Part I of a series of two articles which will deal with audio frequency distortion measurements. Part II will give details of a simple, practical instrument designed to measure distortion in audio amplifiers.

The acoustical quality of an audio amplifier is related to the amount of distortion prevalent in the amplifier. If conforming to true Class A operation, the output plate current waveshape of the amplifier should duplicate the waveshape of the grid voltage input. Such not being the case, the amplifier has a certain percentage of harmonic distortion which, if excessive, deteriorates the audio quality and becomes annoying to the listener.



DISTORTION IN NON-LINEAR AMPLIFIER

FIG. 1

TYPES OF DISTORTION

There are three types of distortion found in an amplifier: (1) amplitude distortion; (2) frequency distortion; and (3) phase shift. In amplitude distortion, the fundamental plus harmonics are observed in the output. Frequency distortion is caused by the amplifier's inability to amplify all frequencies equally. Phase shift is present when the amplifier has different delays for all frequencies. The amount of distortion increases as the tube is operated outside of the linear portion of the tube characteristic curve, as shown in Fig. 1.

In addition to harmonic distortion, there is intermodulation distortion in audio amplifiers. Both are caused by non-linearity in the amplifier. Intermodulation results in the production of frequencies equal to the sums and differences of a low and high frequency (and harmonics). The intermodulation products of fundamental frequencies F_1 and F_2 are as follows: The intermodulation products do not resemble the original tones in the input.

$F_1 + F_2$ and $F_1 - F_2$

$2F_1 + F_2$ and $2F_1 - F_2$

$F_1 + 2F_2$ and $F_1 - 2F_2$, etc.

Intermodulation distortion measurements more closely correspond to the non-linear distortion detected by the average radio listener than does a measurement of total harmonic distortion. It is interesting to note that intermodulation distortion can be observed even after no harmonic distortion is measurable.

The percentage of total harmonic distortion, represented as the distortion factor, is equal to:

$$\sqrt{\frac{\text{Sum of squares of harmonic amplitudes}}{\text{Sum of squares of fundamental and harmonic amplitudes}}} \times 100\%$$

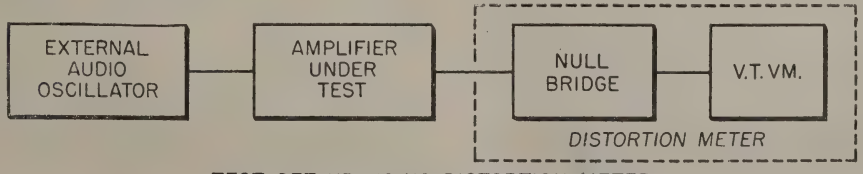
and is measured on the distortion meter. The distorted waveshape can be represented by the Fourier series, and the relative values of the terms of the series indicate the amplitudes of the harmonics in the complex wave.

The harmonic content of the signal includes all of the components which are higher in frequency than the fundamental. Signal components which are lower than the fundamental, such as noise from the power supply, are not usually measured. Total harmonic distortion measurements are most frequently made at 400 or 100 cycles per second. Even though this is the standard practice, additional distortion will usually be present at the lower frequencies. The Federal Communications Commission recommends a measurement of harmonics in audio equipment at frequencies of 30, 50, 100, 400, 1000, 5000, 7500, and 15,000 cps.

DISTORTION METER

Audio frequency distortion measurements can be made by using distortion meters, harmonic wave analyzers, and intermodulation analyzers. The distortion meter will be discussed first.

A distortion meter gives the percentage of total harmonic content and does not show how much of each harmonic is present in the output. A block diagram of the meter is shown in Fig. 2. Basically, it consists of a null bridge and a vacuum tube voltmeter. The null bridge is tuned to the fundamental such as 400 cycles per second and the bridge is balanced at this frequency to entirely remove the fundamental. The vacuum tube voltmeter will then measure only the amplitude of the harmonics. For accurate measurements, the oscillator generating the fundamental test frequency should be completely free of harmonics. In addition, the VTVM should represent the RMS voltage as truly as possible. This can be insured by operating the VTVM in a manner such that the square root of the plate current



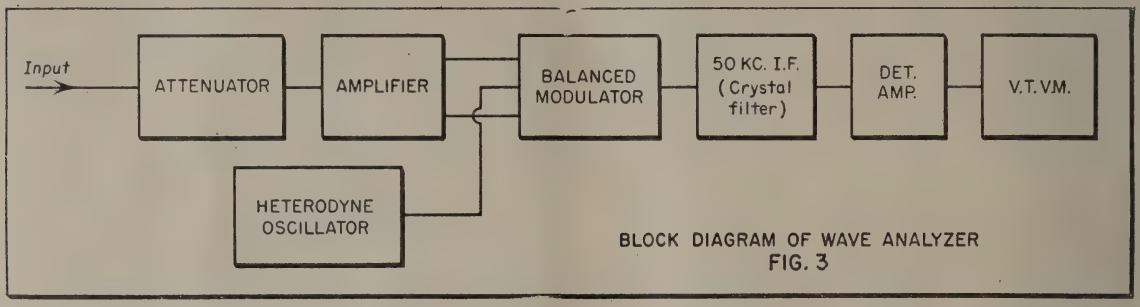
TEST SET-UP USING DISTORTION METER

FIG. 2

versus grid voltage is a linear function.

The distortion meter does not indicate which frequencies are present in the complex-distorted wave and the relative amplitude of each. In addition, certain random noises may be very disturbing to the listener and yet show only a small indication on the meter. Therefore, as in many test measurements, the operator must show sufficient skill to translate the results obtained with the meter into useful data.

A typical commercial distortion meter has a frequency range from 50 to 15,000 cps. The distortion percentage is read directly from a meter with calibrated full-scale deflections of 0.3 per cent., 1 per cent., 10 per cent., and 30 per cent. distortion. A diode vacuum tube voltmeter is used for measuring the percentage of total harmonic distortion. The scale is also calibrated in decibels. A 100,000 ohm unbalanced and a 600 ohm balanced bridge input circuit are provided. Distortion measurements are made on this instrument with an accuracy of approximately 5 per cent. A distortion-free sine wave oscillator should be used with the meter. Otherwise a residual reading will be measured which represents the oscillator distortion rather than that of the amplifier or other audio device being tested. There should be no distortion even at the very low audio frequencies.



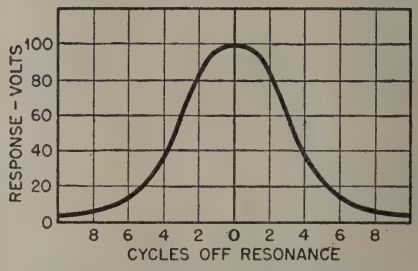
BLOCK DIAGRAM OF WAVE ANALYZER
FIG. 3

HARMONIC WAVE ANALYSER

Unlike the distortion meter, the harmonic wave-analyser is a precision method of measuring distortion and indicating separate components. The wave-analyser tells the operator which frequencies other than the fundamental are in the complex waveform and also gives the amplitude of each harmonic.

Since the analyser must determine the fundamental frequency and all of the harmonics, it is necessary that the instrument be capable of tuning to each of these frequencies and of measuring the amplitude of each. The analyser is really nothing more than a highly selective vacuum tube voltmeter, and is similar to the conventional superheterodyne receiver except that the intermediate frequency is much higher than the input audio signal under observation. The wave analyser has a very narrow bandwidth, otherwise measurements of harmonics components at the very low audio frequencies would be impossible.

The most commonly known wave analyser is the heterodyne type. A block diagram is shown in Fig. 3 and is representative of a commercial analyser. The incoming audio signal is heterodyned with the frequency from a variable frequency oscillator and the resultant frequency is amplified by the narrow bandwidth IF amplifier and read on a vacuum tube voltmeter. When the difference between the oscillator and the input signal frequency is 50 kc/sec., the signal will be tuned to the IF amplifier and the amplitude can be measured on the VTVM. The three-crystal filter incorporated in the IF amplifier assures a very high selectivity. A response curve of the crystal filter is shown in Fig. 4. The heterodyne oscillator covers a frequency range of 34,000 to 49,980 cycles per second but the dial is calibrated from 0 to 16,000 cps. Assume that the incoming signal is 500 cps. This would correspond to an oscillator frequency of 49,500 since 49,500 plus 500 c.p.s. equals 50 kilocycles. A difference frequency $F_1 - F_2$ (49,500 — 500) cannot be amplified. The bandwidth is only four cycles and harmonics can be measured easily at the lowest audio frequencies. The input impedance is one megohm, which is sufficiently high to make loading effects negligible. The VTVM is



CRYSTAL FILTER CHARACTERISTIC
FIG. 4

directly calibrated in volts and decibels and a 5 per cent. voltage accuracy is obtained on all ranges from 300 microvolts to 300 volts full scale. The frequency calibration is accurate to ± (2% — 1 cycle).

Another commercial wave-analyser has the feature of variable selectivity for rapid analysis of the complex wave. Where the harmonics are spaced far apart, the bandwidth may be increased, thus making it easier to make measurements. If the harmonics are closed spaced, as at the very low frequencies, the instrument may be made more selective, to separate harmonics 30 cycles apart. A response curve of this analyser is shown in Fig. 5.

The operation of a wave analyser involves first tuning the oscillator dial to the fundamental and then adjusting the attenuator until the meter reads full scale. Then the harmonics are found by changing the oscillator frequency dial and recording the amplitude of each.

In addition to its use for measuring the distortion in an amplifier, the wave-analyser can be used for measuring distortion in oscillators, transmitters, and telephone systems. It can also be used to determine the harmonics in power machinery and to analyse noise characteristics.

THE INTERMODULATION ANALYSER

A block diagram of a typical commercial intermodulation distortion meter is shown in Fig. 6. The amount of distortion is maximum at the highest and lowest trans-

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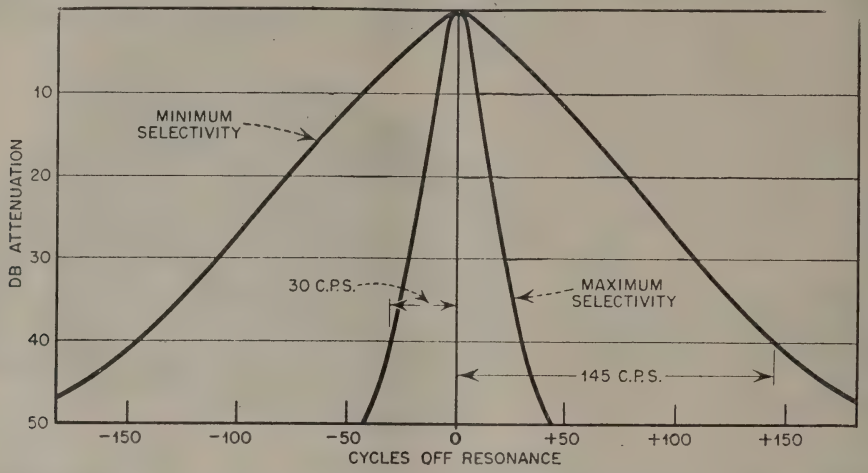
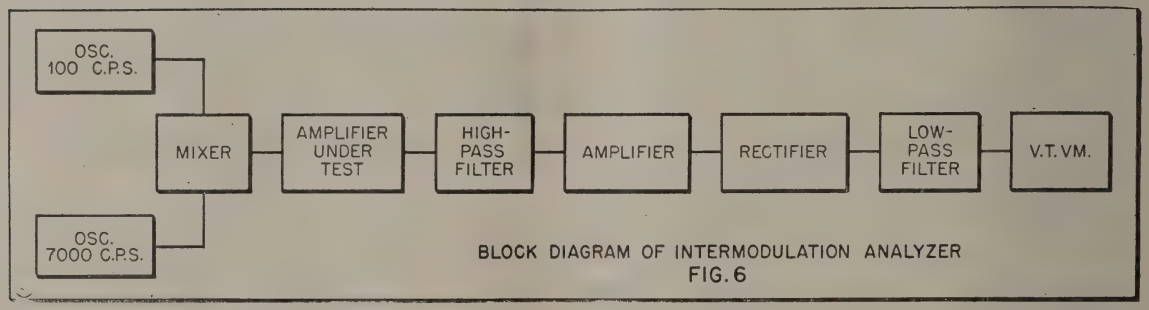
mitted frequencies. However, this discussion will be concerned mainly with intermodulation distortion measurements at the very low audio frequencies. At low frequencies, maximum power output from a tube is not realized because of impedance changes in transformers and reactances. The power output is similarly reduced at the higher frequency because of increased leakage and distributed capacity.

$$(h_1\ h_2\ h_3\ \ldots\ h_n) \times (n)$$

where h_1, h_2, etc., are the harmonics and is the order of harmonics. As an example, 10 per cent. intermodulation distortion is often equivalent to about 2.5 per cent. total harmonic distortion. Since there are no definite standards for these measurements, any figure of intermodulation distortion must be accompanied by a statement of test conditions.



VARIABLE SELECTIVITY RESPONSE CURVES
FIG. 5



BLOCK DIAGRAM OF INTERMODULATION ANALYZER
FIG. 6

In operation, two frequencies shown on the diagram (Fig. 6) as 100 and 7,000 c.p.s. are combined in the mixer. The purpose of the 7,000 c.p.s. signal is to act as a carrier for the low frequency components. These two frequencies are commonly used, but a lower frequency ratio must be used if the amplifier under observation has insufficient bandpass. For best sensitivity, the amplitude of the lowest frequency should be 12db above the higher frequency—a voltage ratio of 4 to 1. The output of the mixer is fed to the amplifier under test and its harmonics. The resultant signal, which is 7,000 c.p.s. modulated by 100 c.p.s., is amplified and demodulated by the rectifier. It is then fed to a low pass filter to eliminate 7,000 c.p.s., and the output is fed to a VTVM where the intermodulation products are present and the percentage of intermodulation distortion is read directly from the meter.

There is no direct relationship between the percentage of total harmonic content and the percentage of intermodulation distortion. With a 12 db ratio for the above frequencies, some authorities claim the percentage intermodulation distortion is equivalent to;

It is hoped that this brief discussion of audio frequency distortion measurements will be helpful in clarifying the general subject distortion measurements. The next article will be especially helpful to those who wish to construct a simple meter for rapid measurement of the percentage of total harmonic distortion and identification of harmonic wave components.

REFERENCES

1—Terman's Radio Engineering Handbook, pp. 939-947.

2—Radio News, Theory of Wave Analyser, Oct. 44, p. 44.

3—Wireless World, Intermodulation Distortion, April 50, pp. 122-125.

4—Radio Test Instruments, by R. P. Turner, Distortion Meter, p. 192.

5—Radio News, Audio Measurements, Nov. 48, p. 3.

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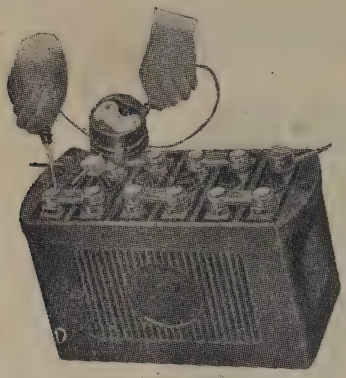

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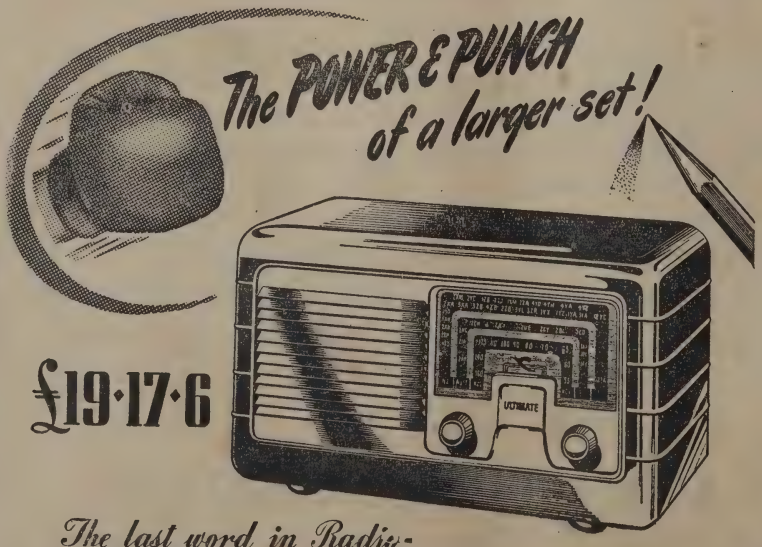

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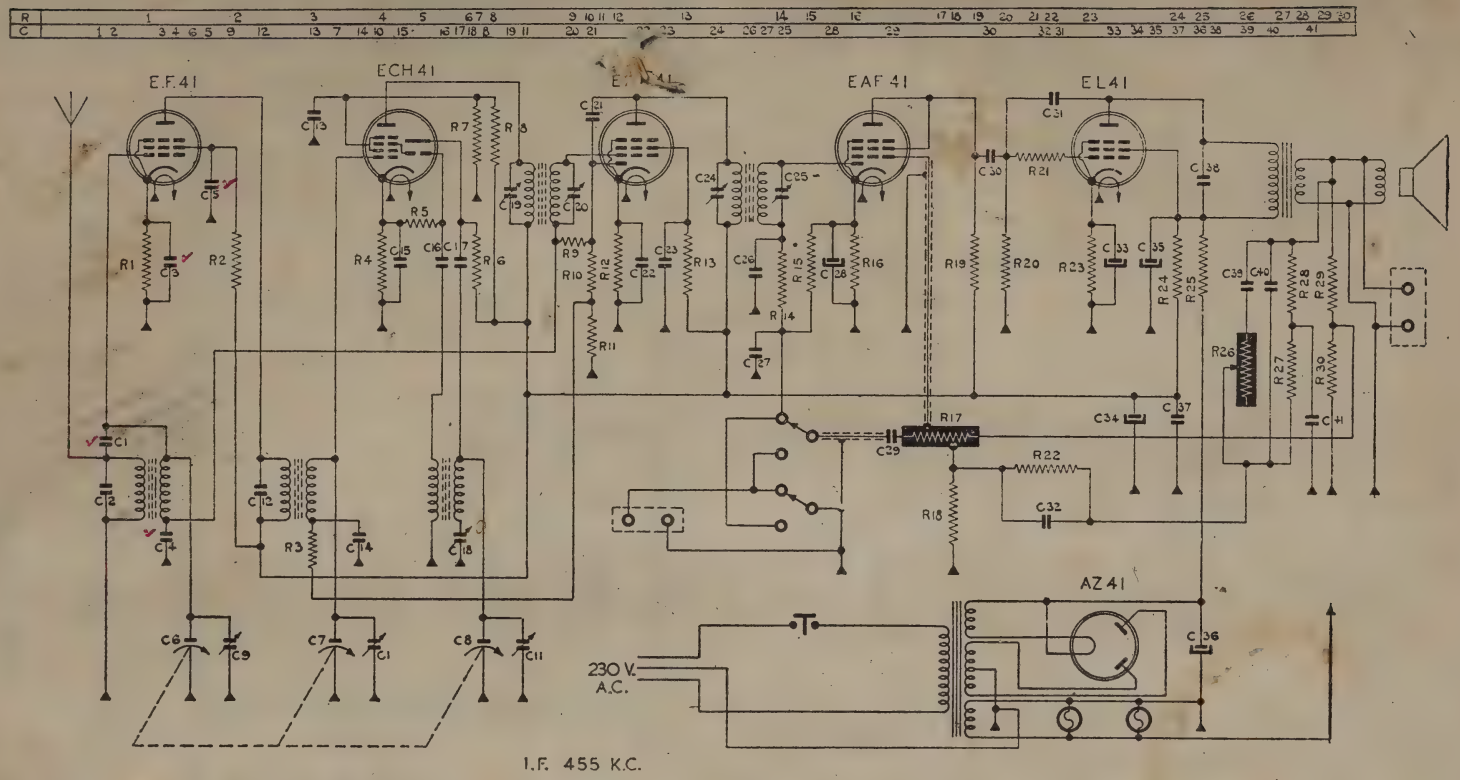

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C20 I.F trim. in I.F. can.
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C27 100 mmfd. ceramic
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C30 .02 mfd. 400v. paper
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C34 20 mfd. 400v. Triple
C35 40 mfd. 400v. Electrolytic
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R1 330 ohms. ½ W. carbon
R2 100 k. ½ W. carbon
R3 2.2 meg. ½ W. carbon
R4 220 ohms. ½ W. carbon
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R6 25 k. ½ W. carbon
R7 47 k. ½ W. carbon
R8 25 k. ½ W. carbon
R9 2.2 meg. ½ W. carbon
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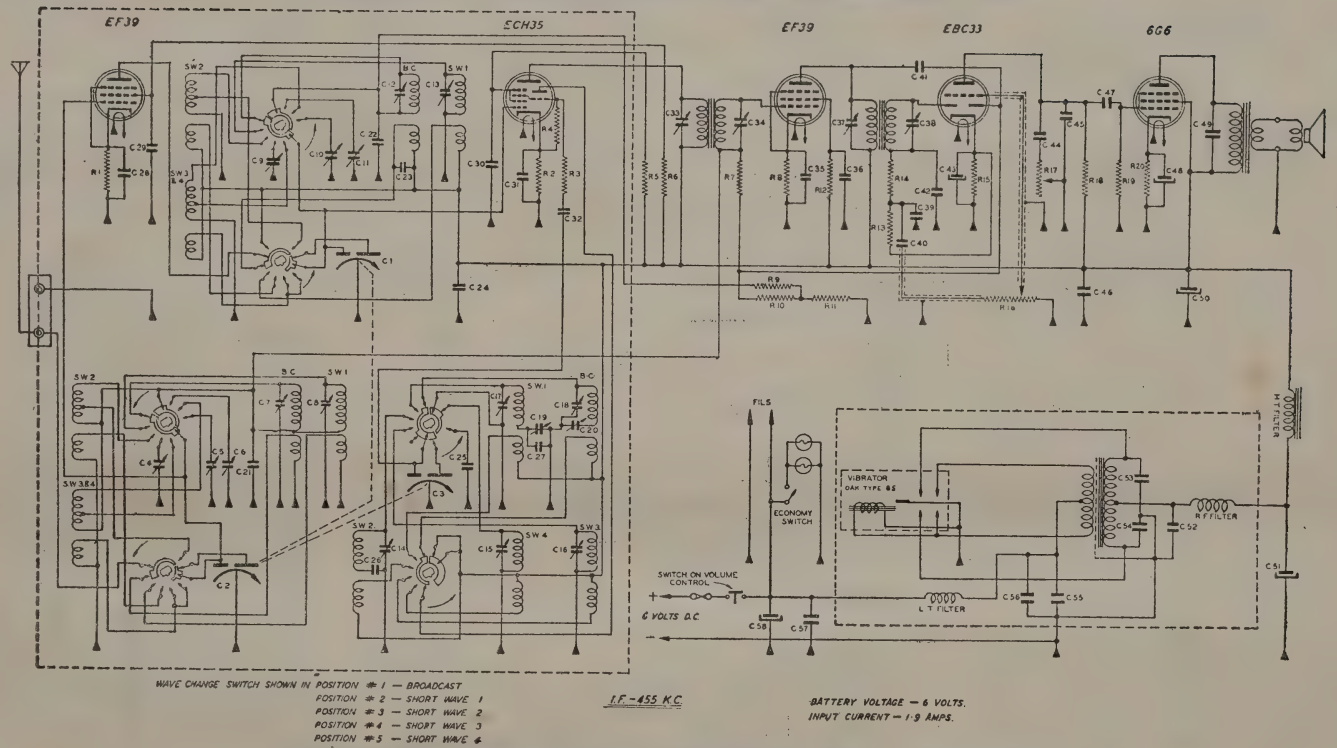

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C41 10 mmfd. ceramic
C42 100 mmfd. ceramic
C43 25 mfd. 25v. electrolytic
C44 .01 mfd. 400v. paper
C45 250 mmfd. mica
C46 .25 mfd. 600v. paper
C47 .047 mfd. 400v. paper
C48 25 mfd. 25v. electrolytic
C49 .005 mfd. 400v. paper
C50 32 mfd. 350v. electrolytic
C51 32 mfd. 350v. electrolytic
C52 .01 mfd. 600v. paper
C53 .01 mfd. buffer condenser
C54 .01 mfd. buffer condenser
C55 .25 mfd. 100v. paper
C56 .01 mfd. mica
C57 .01 mfd. mica
C58 500 mfd. 12v. electrolytic
R1 180 ohms ½ watt
R2 180 ohms ½ watt
R3 180 ohms ½ watt
R4 50,000 ohms ½ watt
R5 15,000 ohms ½ watt
R6 20,000 ohms ½ watt
R7 2.2 megohms ½ watt
R8 200 ohms ½ watt
R9 2 megohms ½ watt
R10 470,000 ohms ½ watt
R11 1 megohm ½ watt
R12 65,000 ohms ½ watt
R13 .5 megohms ½ watt
R14 50,000 ohms ½ watt
R15 5000 ohms 1 watt
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R20 500 ohms ½ watt

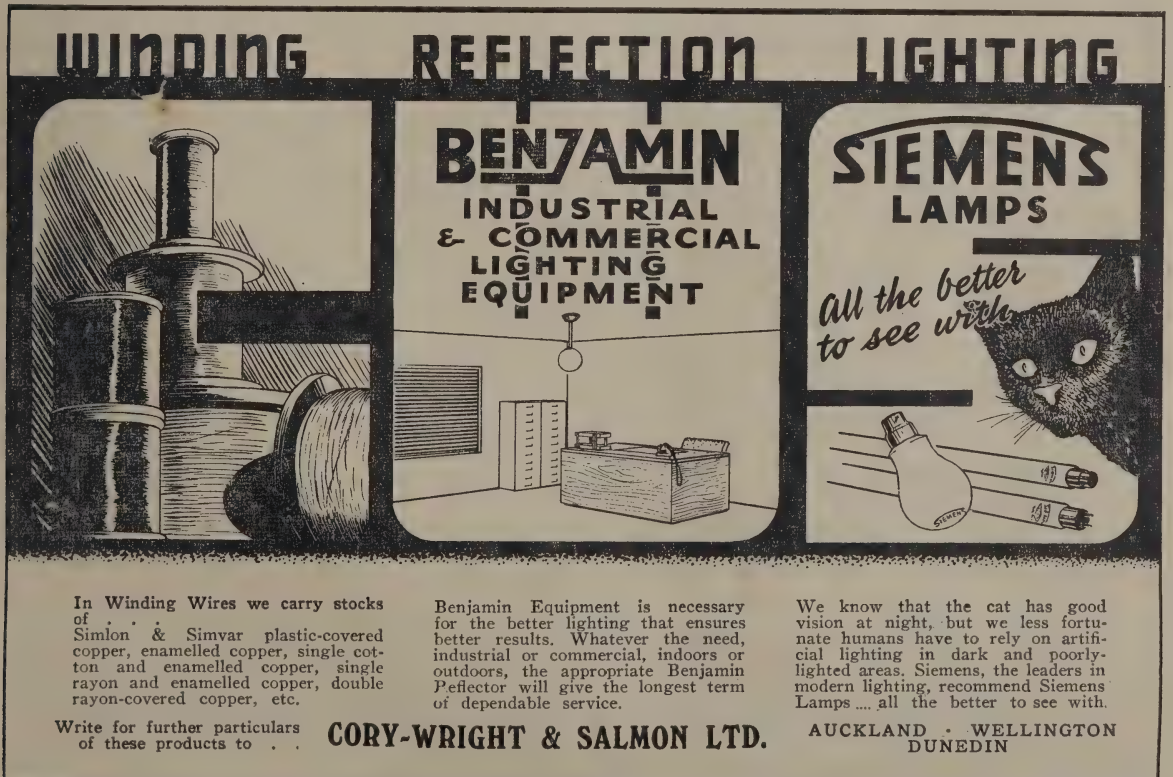
Book Reviews

Television Receiving Equipment, by W. T. Cocking, M.I.E.E.; publishers, Iliffe and Sons, Ltd. Price in U.K., 18s.

With the stirring of interest in TV that has occurred in this country of recent months, many technical men who have hitherto read little, at least in detail, about the theory and circuitry of television will no doubt wish to take up some reading along these lines. Those who do will find *Television Receiving Equipment* an excellent introduction to the subject. The book assumes a sound knowledge of ordinary radio techniques, and it is for the existing radio man that it is to be recommended. The subject is so wide a one, that for the author to have started at a lower level would have necessitated much elementary material that would have been of no interest to the radio technician who wishes to enlarge his sphere of activity by reading TV. Everyone is familiar by now with the broad principles of television, so that while the author wisely includes at the very beginning a short chapter on the usual matters of dissection of an image by scanning, interlacing, etc., this appears to be done more for the sake of completeness than anything else. Those whose existing ideas are very elementary, however, would perhaps do better to consult first a volume which devotes rather more space to the fundamental ideas behind the dissection and reproduction of an image by television before tackling the present volume. It is not intended to imply that the treatment is difficult or mathematical, for nothing could be farther from the truth. On the contrary, it is largely descriptive, and Mr. Cocking's well-known gift of exposition is well to the fore in this, as in his other writings.

There are twenty-three chapters, each dealing with one of the major topics with which the designer of a TV receiver is concerned so vitally. Throughout, the emphasis is on current practice among receiver manufacturers in the United Kingdom, and a particularly valuable feature is the way in which the author evaluates the respective merits and disadvantages of the several stock methods of performing the various necessary functions. The reader realizes, with more force than ever, that electronic design is not so much a matter of laying down absolute requirements, and then designing circuits which fulfil them exactly, as one of designing a circuit which gives the best possible performance in spite of the known limitations of some of the circuits used. For example, the design of deflecting coils and transformers is a matter where many conflicting requirements prevent any one of them from being fulfilled as completely as theory would deem desirable, and a satisfactory design amounts to a very nice discrimination in the exercise of compromise.

However, the book is not really one for would-be designers of TV receivers, although suc persons would find a great deal of useful material in it; it can be thoroughly recommended for use by servicemen who wish to become armed against the probable necessity of having to break into TV servicing, and also for more advanced amateurs who wish to begin experimenting, or who will want to build their own receivers when the time comes. The author has an excellent chapter on "The Complete Receiver" in which typical examples of pre- and post-war receiver design are discussed as a



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Mullard

VALVE NEWS

TELEVISION BY MULLARD

We are indeed proud to announce that once again* MULLARD *have taken the initiative in producing a complete range of valves specially designed for television, and supplies of which are now en route to us and will shortly be available from stock. The intense interest in the recent television demonstrations has shown us that television is, in fact, almost a realization in New Zealand, and because of this, many amateurs and manufacturers alike are at present building and experimenting with television receivers, and will, no doubt, be glad to avail themselves of the opportunity of using* MULLARD *valves designed and developed for television. These valves are of miniature size, using the new noval base, and can be operated on either series of parallel networks A.C. or D.C. Preliminary details are given below, and full technical specifications and details will be forwarded on request.

DOUBLE TRIODE ECC81
All glass, intended primarily for use as oscillator mixer and R.F. amplifier in superhet television receivers. The adoption of a triode mixer section results in a low noise figure and low internal capacitances ensure efficient operation on H.F. television bands.

R.F. PENTODE EF80
Designed as R.F. and I.F. amplifier, its characteristics make it also suitable as a video amplifier, mixer, and in some forms a synchronizing pulse separator.

DOUBLE DIODE EB91
Each section has an independent cathode and an electrostatic shield between sections. One diode can be used as a vision or sound demodulator, and the other for functions such as interference limitation or D.C. restoration.

NONODE F.M. DETECTOR EQ80
Designed as an F.M. detector and operates on a fundamentally different principle from other detectors. Frequency variations are first transformed into amplitude variations and are then detected by conventional means.

VIDEO OUTPUT PENTODE PL83
High mutual conductance and low internal capacitances are features of this valve, and enable it to be used in place of an EF80 where larger outputs are required, or in high definition systems where an EF80 would be inadequate.

TRIODE PENTODE ECL80
Combining a triode and an output pentode in a single envelope, the possibilities of this tube are almost endless. For instance, the triode section may be used as a frame blocking oscillator, line blocking oscillator, or A.F. amplifier, and the pentode as frame or sound output or sync. separator, and so on.

LINE OUTPUT PENTODE PL81
In spite of small dimensions, this tube can deliver a peak anode current of 350 m/a at an anode voltage of 70 volts and screen 170 volts.

BOOSTER DIODE AND RECTIFIER PY80
May be used as half-wave rectifier at 180 m/a at 250 volts, and, as a booster diode, withstands peak inverse voltages of 4 kv. such as may occur during the flyback.

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whole, the separate parts having previously been dealt wtih individually.

As might have been expected, the book is written only with reference to British transmission standards, and thus to British receiver practice. It is worthy of note that when we get TV in this country, receivers are likely to follow British design in some respects, whatever the transmission standards decided upon. For example, it is unlikely that for many years, manufacturers will be faced with the problem of having to produce, as in America, sets which can be tuned to any one of a relatively large number of channels. The British practice of single-channel receiver manufacture is likely to be followed here, and this will no doubt help considerably in reducing complication and costs. It is not considered that a good book on TV is really any the worse for not making comprehensive treatments of both British and American receiver practice, since the differences between the two can readily be assimilated by one who has gained experience or knowledge of one or the other system.

This book is in the best tradition of British technical literature, and one that can be thoroughly recommended to those wishing to bring themselves up to date on modern receiver practice.

Handbook of Broadcasting (third Edition) by Waldo Abbot. Published by the McGraw-Hill Book Company.

The sub-title on the dust-jacket of this book reads "The fundamentals of AM, FM, FAX, and TV," so that it comes as rather a shock to find, on opening it, that broadcasting means actually saying one's piece over broadcast, FM, and TV stations. It is written by a Professor of Speech and Director of Broadcasting at the University of Michigan, and in the author's own words in the preface to the first edition, "is designed for teachers and students of broadcasting, for those listeners who are interested in how programmes are planned and presented, and for those who may be called upon to speak to 'Mike.'"

Although primarily addressed to those American citizens who may wish to become announcers, programme directors, script-writers, etc., in American broadcast stations, it will repay considerable study by those who are interested in the broadcast word in all its manifestations. The whole is coloured, of course, by the fact that broadcasting, in America, is purely commercial, and gives the reader an excellent idea of the attitude of broadcasters in that country towards their work. It also throws considerable light on the whys and wherefores of some of the (to us) most noteworthy features of such American programmes as we have heard in this country. For instance, the shorter chapter entitled "Radio Humour" explains admirably why comic programmes that we ourselves have appreciated, like "ITMA," "Much-Binding-in-the-Marsh," etc., would not have the slightest appeal to American audiences. In giving instruction to would-be humorous script-writers, the author says:

"Unlike the announcer, he (the comedian) must have copy, he can't punch his humour across with volume and speed . . . . Don't crowd the jokes ,don't overlap the laughs, give the listener time to appreciate, to understand, to explain the joke to his wife."

And in another place in the same chapter:

"Human beings in amusing situations make the listener feel that he is in like circumstances. It is the effect that counts. Good-humoured slapstick and the "belly-laugh" pay the sponsor, not wit. Noel Coward and Oscar Wilde need not apply."

Perhaps now we can understand why American comedy programmes appear to us to be slow-going, to labour

their points, and to rely on humour of a very "obvious" kind. And perhaps it is no longer remarkable that Bob Hope is reported to have said, after hearing and seeing a Tommy Handley show produced, that the pace would kill him—he couldn't keep it up. In spite of the rapidity of the succession of laughs to be found in some English programmes one has yet to hear the audience complaining that it didn't have time to explain the last one to its wife—or even to hear the said wife complaining that she needed it explained to her!

These comments, however, are by the way. The author is writing for American readers, but they do serve to illustrate that we can learn quite an amount from Professor Abbot's book about some of what seems strange to us in American broadcasting, even if we have never experienced it ourselves.

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48 S 12	10 watt	C.T.	11 H		
48 S 22			7.5 H		
48 S 03	6A3's	3,000 ohms	36 H	5 mh	80 ohms
48 S 13	15 watt	C.T.	9.5 H		
48 S 23			6.5 H		
48 S 04	EL37's	4,000 ohms	48 H	5.5 mh	110 ohms
48 S 14	15 watt	C.T.	16 H		
48 S 24			11 H		
48 S 05	PX25's	5,000 ohms	69 H	8 mh	160 ohms
48 S 15	15 watt	C.T.	19 H		
48 S 25			13 H		
48 S 06	KT66 or 807's	10 000 ohms	130 H	15 mh	250 ohms
48 S 16	15 watt	C.T.	45 H		
48 S 26			30 H		
48 S 07	EL37's	4,000 ohms	54 H	16 mh	170 ohms
48 S 17	20 watt	C.T.	15 H		
48 S 27			11 H		
48 S 09	PX25's	10,000 ohms	145 H	16 mh	250 ohms
48 S 19	20 watt	C.T.	48 H		
48 S 29			33 H		
48 S 10	KT66 or 807's	10,000 ohms	130 H	15 mh	250 ohms
48 S 20	15 watt	C.T.	45 H		
48 S 30			30 H		

PHYSICAL DIMENSIONS

Power	Width	Length	Height	Mtg. Centres	Weight
5 watt	2¼ in.	3½ in.	2¼ in.	3⅛ in.	1¾ lb.
10 watt	2½ in.	3⅞ in.	3¼ in.	2⅛ in. x 2¼ in.	3½ lb.
15 watt	3¼ in.	4½ in.	3⅞ in.	2⅝ in. x 2½ in.	6½ lb.
20 watt	3¼ in.	4¾ in.	3⅞ in.	2⅝ in. x 2¾ in.	7 lb.

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SOME WAVE-FORMS AND HOW TO MAKE THEM

PART II

NOMENCLATURE OF PULSES

At the end of the first instalment of this article, we were discussing the nature of pulses, as distinct from square-waves, and saw that an appropriate definition can be made by regarding pulses as special cases of square waves, in which the portions above and below the datum line are not equal in amplitude. The difficulty that sometimes causes confusion to the newcomer is that different writers call what appear to be identical wave-forms by different names. There is a certain amount of justification for this, because a wave like that of Fig. 1 (b) can just as easily be called a positive-going pulse, or a negative-going square-wave *if the datum line is not inserted.* For example, as we have drawn it in Fig. 1 (b), it could hardly be called anything but a positive-going pulse, but if a D.C. component is added, it is possible to shift the datum line up to, say, the tops of the narrow portions. In this case, it might be more appropriate to call it a negative-going square wave, because the operative portion of the wave is now the longer, negative-going portion rather than the shorter positive bit, and because the idea of *shortness* inherent in the name "pulse", is then missing. In the literature, one is liable to come across either term for what will sometimes appear to be the same thing, because of the common, but undesirable habit of leaving out the datum line, and thus showing merely the shape of the wave. However, forewarned is forearmed, and if this fact is realized in advance, much confusion will be saved the student who is new to the subject.

For instance, one might just as easily call (b) a positive pulse, or a negative square-wave. In general, what it *is* called, will depend not only on its shape, but on how it is to be used. The difficulty is increased somewhat because very often the datum line is artificially shifted by inserting a D.C. component, so that the term "pulse" becomes inapropriate because of the inherent meaning of "shortness" that belongs to the word. However, if this difficulty is realized by the reader, he will find descriptions much easier to understand as, for example, when a wave like (c) is changed by bringing the datum line down to the tips of the negative-going portions, and yet the writer refers to it as a negative pulse still.

USES OF SQUARE-WAVES AND PULSES

The uses of square-waves and pulses are almost unlimited. It can be said briefly that they are used in any application where the timing of operations is required, on a regular, recurrent basis. The most obvious application is that of synchronizing the receiver time-bases in a TV receiver with those at the transmitter. Another important application is the synchronizing of the several operations that take place in a radar system. Yet another is the establishment of accurate time intervals in pulse-modulated multiplex telephony systems, not to mention the use of the pulses, modulated in some way, for actually conveying the several sets of intelligence.

Allied to timing operations are switching operations. For this purpose, square-waves are usually employed, as in the electronic switch used for making two pictures visible at once on the screen of the same cathode ray tube. Electronic switches have also been used in radar for automatically feeding the outputs of several aerials, in a definite time sequence, to the one receiver, and at the same time for switching the C.R.T. display circuits so that the signals from each aerial can be seen separately, and identified.

Electronic switches have also been used for automatically arranging for the strongest signal from a number of aerials to be heard in a set of diversity receivers, and for automatically producing repetitive sequences of events such as the operation of signal lights, etc.

Square-waves, in combination with saw-tooth waves, are used for measuring small time intervals, from microseconds upwards, and for performing a multitude of functions too numerous to mention. The examples given in this paragraph are only a few that spring readily to mind without any special thought. They are enough, however, to indicate that practically all the non-radio uses of valves find some application for square-waves and their generating circuits. They are to be reckoned a topic of major importance to anyone who aspires to know anything of electronics, as distinct from simple linear amplifiers and radio receivers, which themselves are no more than a special kind of linear amplifier.

METHODS OF GENERATING THEM

Perhaps the first important thing about the generation of non-sinusoidal wave-forms is the question of what they are made from. In general, they can be made in one of two ways, each of which is important, and has its own uses. The first way is to generate them directly by means of special oscillators, while the second is to start off with a sine-wave, and modify, or distort it, until the wave shape is the one needed for the purpose in hand. The main advantage of the first method is that it usually needs fewer valves, while the second method has the advantage that while several steps are needed, and several valves, it is often possible to use intermediate wave-forms throughout the chain for purposes required by the complete equipment for which the square-waves or pulses are being generated. These wave-forms are seldom an end in themselves, but are usually means of making an equipment perform its particular functions. The same thing can be said of the signals from a microphone, in that the electrical output of the microphone is simply a means whereby the use of amplifiers is made possible, since amplifiers are needed to operate loud speakers.

Very often, a combination of both methods is used, in which a sine-wave is used as a frequency standard, and a particular point on each cycle as a time reference point. In this case, the actual square-waves used may be made by multivibrators of one sort or another, synchronized by means of pulses derived from the original sine-wave for that specific purpose. In this article, however, it is intended to deal with the second method, as readers of this journal will have become reasonably familiar with the simple multivibrator. Besides, these interesting circuits are themselves material for several articles! Indeed, the whole subject of non-sinusoidal waves and their generation is one about which large and weighty volumes have been written. It is thus not possible in an article of this kind to do more than skim the surface.

THE DISTORTING AMPLIFIER

Perhaps the most widely used method of generating wave-forms from sine-waves is to use an amplifier, designed and arranged to distort the sine-wave in a particular manner. Those who have looked at the output of an audio amplifier using an A.F. oscillator and an oscilloscope will have more than a clue as to how this is done. If a valve is biased in the centre of the straightest por-

tion of its characteristic, and if the input voltage is kept within certain prescribed limits, then the A.C. output voltage is an almost distortionless reproduction of the input wave, regardless of its shape. Of course, amplification is obtained at the same time, and for ordinary purposes this is the desired end. But if the input voltage is increased, two things happen. The negative half-cycles swing the grid of the amplifier valve past its cut-off voltage, and the positive half-cycles swing it positive, so that the current through the valve no longer increases when the grid voltage goes more positive still. Now both these occurrences cause the output voltage to lose all resemblance to a sine-wave, and it will be found that if the A.C. input voltage is increased sufficiently, the output wave will resemble Fig. 1 (a) much more closely than it resembles the original sine-wave.

This, very briefly, is the principle on which square-wave and pulse generators work. There is a good deal more to the question than that, however, and actual pulse generators are specially designed for the purpose, and not just overloaded amplifiers. But the principle of the over-driven amplifier is the basic idea behind a whole family of important circuits, which we will discuss in the next instalment of this article.

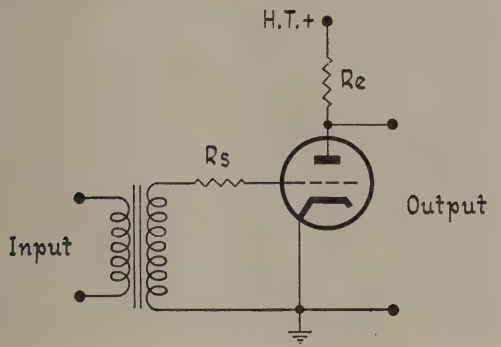


Fig. 2

One of the simplest distorting amplifier circuits is that shown in Fig. 2. Here we have a small triode, such as a 6C5, 6J5, or half of a 6SN7; in the plate circuit there is a load resistor, R_L, there is no grid bias, and the input is supplied from a transformer, through a series grid resistor, R_s.

The action of this circuit is as follows. Without any signal input, the valve will not draw excessive current, in spite of the fact that there is no bias, because of the relatively high value of load resistor. The input transformer provides approximately 100v. R.M.S. at its secondary terminals, and thus each half-cycle has a peak value of approximately 141 volts. The grid of the valve, in the absence of R_s would thus be driven between the limits of plus 141 volts and minus volts once in each cycle of the input voltage. First of all, let us see what happens on the negative half cycles. The valve does not draw grid current at this time, because the grid is negative with respect to cathode for the duration of the half cycle. Because of this, there is no voltage drop in R_s, and the full negative voltage of the input is applied to the grid. Because of the large input voltage, however, the valve becomes cut off after a very short time, but during the period in which the valve is still conducting, there will be a sharp rise in plate voltage, corresponding to the rapid fall in grid voltage, and actually being an amplified version of this part of the input voltage. However, as soon as the input wave takes the grid to cut-off, conduction ceases, and so does the rise of plate voltage. At this point, the plate voltage is equal to that of the H.T. line, because since there is no plate current, there can be no voltage drop in the load resistor. From now on, the valve remains cut off while the input wave completes the negative-going quarter-cycle, and reaches its maximum, or peak negative value. The voltage then starts to rise once more, but until it reaches the cut-off bias for the valve, the latter remains at cut-off. Now as long as this happens, the plate voltage remains static and equal to the H.T. voltage, so that during this cut-off period, the output wave is a horizontal straight line, following the very quick rise mentioned above. But as soon as the input voltage reaches cut-off while proceeding in the upward direction, the valve starts to conduct again, and this it does for the whole of the remainder of the cycle. But while the input is travelling up from cut-off to the grid current point, the valve amplifies once more, and this time, the output is a rapidly falling plate voltage, and is an amplified version of the part of the input cycle which is crossing the grid-base of the valve. This process is illustrated graphically by Fig. 5, which gives a physical picture of what is happening over the whole cycle of the input voltage. This diagram shows the grid volts/plate current characteristic of the valve, and the input and output wave forms. The dotted input wave form represents the 100v. R.M.S. input, and the figure illustrates why, with such a large input voltage, the times during which the valve conducts and amplifies, are so very short. The full-line part of the input wave is the effective part, for once the valve is cut off (referring again to the negative half-cycle), the shape of the input wave has no further effect on the shape of the output wave. (Note: In Fig. 5, the time scale for the input wave is from top to bottom of the picture, and for the output wave, from left to right.) If the figure is examined in conjunction with the description we have just given, it will be possible to visualize quite clearly what happens, and how the square-cornered *positive* half-cycle of output arises.

What, then, of the negative output half-cycle? This obviously occurs during, and corresponds in time to, the positive half-cycle of the input voltage. We have already described the rapid drop in plate voltage (AA on the diagram) which occurs while the input wave form is crossing the grid-base of the valve during the latter portion of the negative half-cycle and the beginning of the positive half-cycle. It is important to note that the datum line for the input wave is the zero-bias line, since there is no bias on the valve. The only portion of the output wave left to explain is the portion AB, in which the plate voltage is once again constant for a considerable time, but this time at a very low value. It will be seen that the valve has been shown as possessing a characteristic in which, after the grid has risen to only a few volts positive with respect to cathode, the plate current ceases to rise at all. If this is the case in practice, then once the input wave has driven the plate current to this saturation value, any further increase of positive voltage can no longer increase the plate current. This then remains constant, and high in value. There is thus a large and constant voltage drop through the plate resistor, giving the portion AB of the output wave, until the input wave-form returns on its downward journey to complete the positive half-cycle.

The purpose of the series grid resistor has yet to be explained, however. The chief reason for its presence

is that some means must be provided of preventing a very heavy, damaging flow of grid current from occurring during the positive half-cycle of the input voltage. Obviously few valves will stand positive grid voltages of over 100 volts for long without the grid becoming overheated through excessive grid current; the insertion of the series resistor actually prevents a very high positive grid voltage from occurring in any case, while having no adverse effect on the output wave-form. From an examination of Fig. 5, it can be seen that as long as the grid voltage goes the few volts positive that are needed to drive it into the saturated condition, any further positive voltage on the grid is unnecessary. Thus, R_s is inserted to act as a voltage divider, *but only during the*

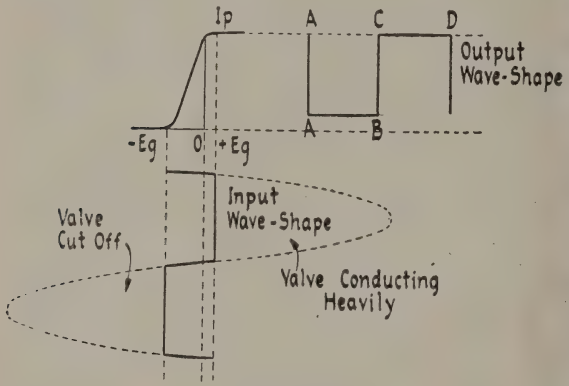


Fig. 5

positive half-cycles. More strictly, the voltage divider action takes place only while the valve is drawing grid current. When this happens, the grid-cathode circuit inside the valve acts as a low resistance of only a few thousand ohms. If R_s is made high in value, it acts, together with a grid-cathode resistance as a voltage divider, so that only a small fraction of the input voltage is actually applied to the grid while grid current is passing. The net result is that contrary to first expectations, the valve never has its grid more than a very few volts positive, so that the high positive input voltage does no harm. Needless to say, the voltage dividing action does not take place once grid current ceases, and thus R_s has absolutely no effect on the *negative voltage* applied during the negative half-cycle, and thus, no effect on the shape of the output wave during this time.

This circuit can be seen to produce an output very similar to Fig. 1 (a), in that the positive and negative half-cycles are of almost equal duration. With this arrangement they are not *quite* equal, because as can be seen from Fig. 5, the datum line for the input wave is nearer the saturation grid voltage than cut-off. The negative half-cycle of the input will therefore affect the plate current for a slightly shorter period than will the positive input half-cycle. This will make the output *positive* half-cycle slightly shorter than the negative one, but only very slightly shorter. The larger the input voltage, the smaller will be the time difference between the length of the half-cycles.

PRACTICAL PERFORMANCE OF THE CIRCUIT

In order to demonstrate the actual performance of some of the circuits about which we are writing, test circuits were constructed, and the actual wave-forms

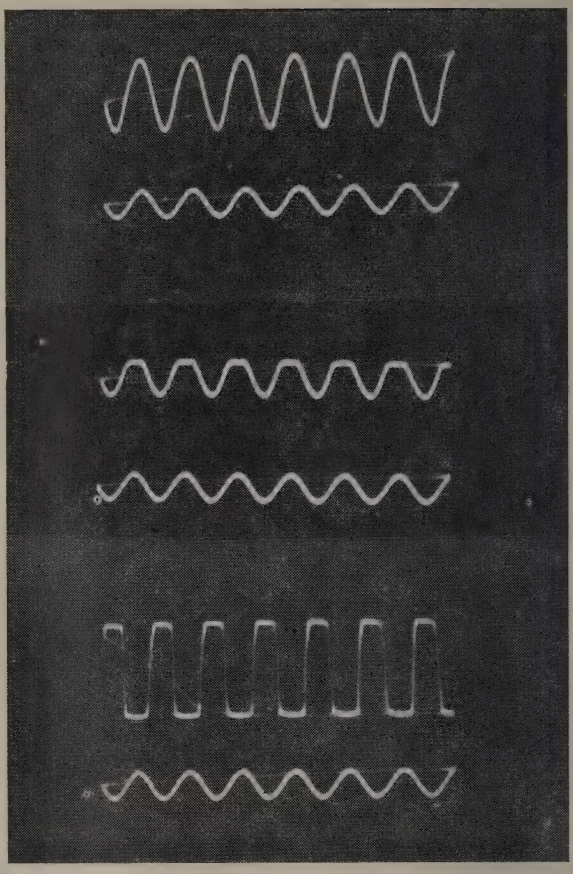


Fig. 6.

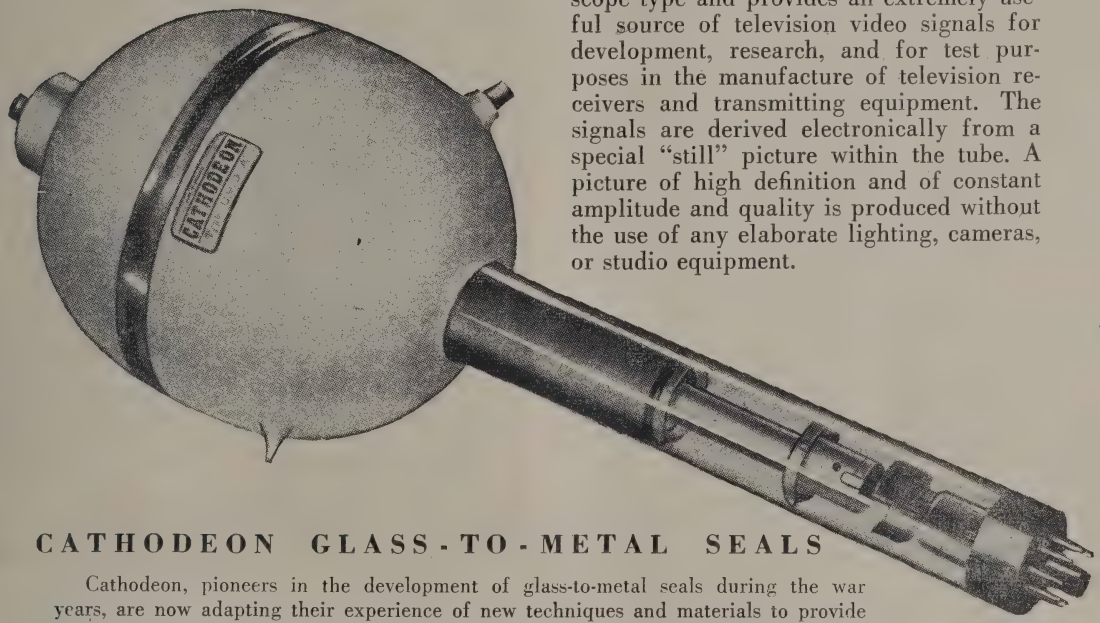
from them were photographed on the oscilloscope screen. The photos relating to the circuit of Fig. 2 are shown in Fig. 6. There are three pairs of wave-forms in this photograph. Each pair was taken at the same time with the aid of an electronic switch. By this means, it was possible to display the original sine-wave on one trace, and the derived wave-form from the test circuit on the other, thus showing the time relationships between the manufactured waves, and the original one. In each pair of wave-forms, the lower trace is the original sine-wave, while the upper ones are the derived wave-forms. At the top, we have the wave-form at the second of the transformer. It will be noted that it is larger in amplitude than the original sine-wave, and also that the transformer has distorted it somewhat. The middle pair show the wave-form at the grid of the valve. This demonstrates the clipping action of the grid-current, in conjunction with the series grid resistor. The upper portions of the positive half-cycles have been lost, and it can be seen that only the negative half-cycles are left. The bottom pair shows the output wave-form on the upper trace, and several points can be seen. First of all, it is clear that the "vertical" portions of the wave are very steep, but are certainly not vertical, especially near the cut-off and grid current points. This is because the characteristic of the valve does not have perfectly sharp transitions at either place, and indicates that the output

(Continued on Page 41.)

CATHODEON

TELEVISION PICTURE GENERATOR TUBE

PYE



This picture generator tube is the Monoscope type and provides an extremely useful source of television video signals for development, research, and for test purposes in the manufacture of television receivers and transmitting equipment. The signals are derived electronically from a special "still" picture within the tube. A picture of high definition and of constant amplitude and quality is produced without the use of any elaborate lighting, cameras, or studio equipment.

CATHODEON GLASS-TO-METAL SEALS

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The PHILIPS Experimenter

An Advertisement of Philips Electrical Industries of N.Z. Ltd.

No. 42: An Experimental Final Amplifier for Six and Ten Metres Part III

TUNED CIRCUIT COMPONENTS

The specification for the coils for the amplifier are as follows:—

Plate Circuit for Six Metres

L_2, the plate tank winding, consists of ten turns of 12-gauge copper wire, 1¼ in. in diameter, and spaced to occupy 2 in. of winding space. A gap of approximately ¼ in. is left between the centre turn and the two adjacent turns so that a two-turn coupling link can be inserted between the centre three turns if this form of output coupling is to be used. The coupling link, L_1, can be made from two turns of 16-gauge copper, insulated with P.V.C. spaghetti to prevent it from short-circuiting the turns of L_2.

Plate Circuit for Two Metres

For this band L_2 is no longer a coil, but as described earlier is a section of parallel transmission line. It is made from ⅛ in. diameter brass rod, spaced one inch between centres, and 7 in. long. The "business end" of Belling-Lee banana plugs are soldered to the open ends, to plug into the sockets provided, and the other end is short-circuited by a bar of 16-gauge copper. At the centre of this bar is screwed a further banana plug. The line is bent in the manner illustrated in the photographs, and the outside diameter of the circular bend is 2 in. This makes the distance between the shorting bar and the ends of the brass rods approximately 2½ in. The exact manner in which the bend is made does not matter, except for fitting the exact plug lay-out used by the individual constructor, and bending the line in this way appears to have very little, if any, effect on the tuned frequency.

The coupling hairpin is made of 12-gauge copper wire, and has the same wire spacing as the tuning line. It is 2½ in. long from the closed end to the end of the copper wire, and further banana plugs are soldered to the wire ends to enable the hairpin to be plugged into the sockets provided. The length of the hairpin is not critical, and it is made of copper so that it can easily be bent to place it at the desired distance from the plate line, to give the required coupling.

Grid Circuit for Six Metres

The grid coil, L_3, comprises eight turns of 20-gauge copper wire, wound to one inch diameter, and spaced as follows. The whole winding occupies 1½ in., but there is a space of approximately ¼ in. between the fourth and fifth turns, so that the coupling turn, L_4 can be inserted. L_4 consists of a single turn of 20-gauge copper wire, of diameter 1 in., as for L_3.

Grid Circuit for Two Metres

The grid circuit for this band consists of a pair of small hairpins mounted horizontally on a plug-in mounting similar to the one made for the six-metre grid coils. The grid hairpin, L_3, is of 16-gauge copper wire with the legs spaced by half an inch, and of a length of 1¾ in. The hairpin is provided with an R.F. choke mounted between the centre of the hairpin and the middle of the three plugs, which, on the conventional coil, is used as a connecter for the centre-tap. The coupling link, L_4, is a similar hairpin 1¼ in. long, half an inch wide, and made of 20-gauge wire. It is mounted under the tuned hairpin, with its closed end adjacent to the closed end of the latter. It can be bent towards or away from the pin to provide variation of coupling.

Tuning Condensers and R.F. Chokes

The grid tuning condenser is a Polar split-stator. It has three close-spaced plates in each section, which has a minimum capacity of 2.2 $\mu\mu$f. and a maximum capacity of 10 μf. This range is great enough for both bands to be covered, both when the Philips QQE06/40 is acting as a straight amplifier and when it is tripling from 48 mc/sec. to 144 mc/sec. With the specified grid coil, it tunes almost at maximum capacity to reach 48 mc/sec., which is the lowest frequency to which it will have to tune under any circumstances. If at first trial it does not cover the ranges just as required, the turns of the tuning coil can be squeezed together or spread apart slightly until the inductance is correct and gives 48 mc/sec. at the low-frequency end of the scale.

The plate tank condenser is also a midget split-stator by Polar, and has a minimum capacity of 2.7 $\mu\mu$f. and a maximum of 8 $\mu\mu$f. per section. It also has five plates per section, but the spacing is much greater than in the grid condenser. This is important, as it decreases the possibility of flash-over, which would almost certainly occur if the very close spacing of the other type were used. This might seem a very small tuning capacity, but it is sufficient for giving the plate tank the required Q at the operating frequencies involved. In fact, the low plate-to-cathode capacity of the sections of the Philips QQE06/40 is the only thing which allows this happy state of affairs to come about, and is an excellent demonstration of the worth of this valve in V.H.F. circuits. Most valves have so high a plate-cathode capacity that at V.H.F. the L/C ratio of the plate tank cannot be made to have the theoretically optimum value. The net result is that such valves are noticeably less efficient at these frequencies than the one we are using here. It is not difficult to see why. In a tuned circuit that is loaded, as is the plate tank of a power amplifier, by the reflected impedance of the transmission line used as the output coupling device, the working Q of the circuit is higher, the greater the tank capacity. If the Q is too high, we have the almost paradoxical situation that the R.F. losses are greatly increased, because high Q means a high circulating current. Since not much can be done about the value of the R.F. resistance of the tank *coil,* it follows that while the valve continues to produce R.F. power in its plate circuit, a great deal of this is expended in heating the tank coil if the circulating current is high. Too high an operating Q, too, makes it difficult to load the amplifier properly, and this is a feature of

using improperly designed tank circuits that many amateurs are completely unaware of. We have mentioned this fact before in these pages, but the point is never so well taken as to make repetition superfluous!

All the R.F. chokes in the amplifier stage are home-made, by winding with fine wire on a small diameter former. An excellent former is a carbon resistor of high value, and having a diameter of about a quarter of an inch. To make the choke, 30-gauge copper wire is used, and close-wound to occupy a space of approximately 1 in. These chokes cost practically nothing to make, but are perfectly efficient at six and two metres.

MODULATION OF THE FINAL STAGE

When working as a straight amplifier on either band, the stage modulates very well in the usual plate-and-screen manner. In this case the modulator power will be the usual 50 per cent. of the D.C. plate and screen input power to the stage, for 100 per cent. modulation. For instance, in testing the circuit for modultion capability, it was run with an H.T. supply of 410 volts (as measured) and, loaded up, had a plate current of 101 ma., and a screen current of 14 ma. The total plate and screen input was thus 47 watts, so that to fully modulate it, an audio power output *at the secondary of the modulation transformer,* of 23½ watts is needed.

Now earlier in this article it was mentioned that there is a possibility, when the stage is acting as a tripler, of modulating it on the plate and screen with considerably less than the normally required 50 per cent. of the plate and screen D.C. input. This can be done by modulating the driver as well, and this scheme was tried with conspicuous success. The conditions under which the stage was working were as follows:—

Plate voltage	380
Plate current	140 ma.
Screen current	10 ma.
Grid resistor	25k.
Grid current	7 ma.
Screen resistor	12.5k.

This gives a total D.C. input to the plate and screen circuits of 57 watts, which if modulation were to be done on plate and screen only, would require an audio power of 28½ watts. But by modulating the driver almost 100 per cent. it was found that the plate audio power required for 100 per cent. modulation with good waveform was only 16 watts. This represents a considerable saving of power. The total A.F. power for modulating both final and driver is still less than 28½ watts, and indeed totals only 21 watts. But approximately 5 watts of this is already in existence, in the form of the modulator for the Philips QV04/7 which is the output stage for the exciter. It then remains only to provide the 16 watts aforementioned, for the plate and screen of the Philips QQE06/40.

ADJUSTING AS A TRIPLER WITH DRIVER MODULATION

With the driver modulated as well as the plate and screen, it is essential to display the modulation pattern

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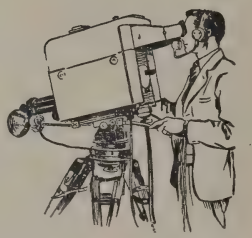

Television in Australia is now fact. In the near future an army of technicians — men who have been soundly trained — will be needed. The Marconi School of Wireless, conducted by Amalgamated Wireless (Australasia) Limited, will be commencing a Television Course in February, 1951. Write and enquire for details to

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on the oscilloscope if respectably linear modulation is to be obtained. First of all, it will be necessary for the audio input to be supplied both to the internal modulator of the driving unit, and to the second modulator for the plate and screen. The best way of doing this is perhaps to leave the internal modulator untouched, but to build the additional modulator with a pick-off after the first stage which can be taken to the input jack of the internal modulator. Then, if a gain control is provided on the additional modulator *after* the pick-off point, it will be possible to get completely independent control of both forms of modulation. Then, a volume control placed at the input of the second modulator can be used as a main modulation control, whic will alter the input to both modulators while leaving the *proportion* between the two power outputs the same.

With these facilities provided, the procedure is as follows. Excitation is applied, and the final is tuned up and loaded in the conventional manner without modulation applied to either the final or the driver. When these adjustments have been completely, the H.T. to the final is turned off, and the oscilloscope is brought into action to display a modulation pattern for the driver. Audio is then applied to the driver's modulator, and the gain control adjusted until 100 per cent. modulation is obtained, or very close to it. Then, the final and the final's modulator are turned on, and the gain control for the final modulator *only* is advanced until the positive modulation peaks are no longer flattened off, but come up until the pattern has the normal shape of a 100 per cent. modulated class C amplifier. When this has been done, a little experimenting, by way of altering slightly the rela-

(Continued on Page 48)

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R.F. Resistance Meter

(Continued from Page 8.)

our own instrument, we have fixed on a standard plate current change of 10 micro-amps. This is quite small enough for all practical purposes, and is not too small to measure. The accuracy of measurement depends largely on the precision with which the current and voltage change can be measured. Thus it is best to use as sensitive a meter as possible for measuring the plate current change.

It is not impossible to estimate the necessary 10 μamps change even if a 0–1 ma. meter is used, but not with any great accuracy, because the movement of the pointer is so small. We have used a 0–100 μamp. movement, so that the 10 μamps on this represents a tenth of the full-scale deflection and can be judged quite accurately. The voltmeter, which measures the increase in plate voltage has a range of 0–5v. This, in conjunction with a measured change of 10 μamps, gives a reading which can be interpreted directly as hundreds of thousands of ohms. That is, a reading of 4v. indicates a resistance of 400,000 ohms, and of 1v., 100,000 ohms.

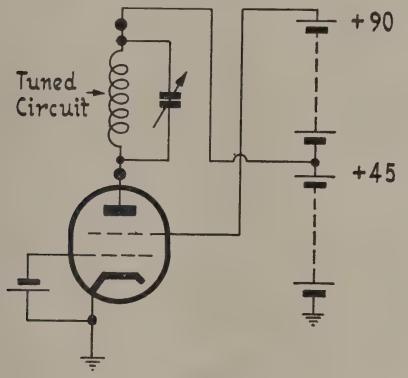

Fig. 2

CONSIDERATIONS AFFECTING A PRACTICAL METER

The circuit of Fig. 2 is quite practical, in so far as it will act as an oscillator as it stands, but for a practical measuring instrument a number of facilities have to be provided, as the above paragraphs will have shown. The essential features which must be added are:—

(1) A means of varying the grid bias smoothly so as to provide a smooth control over the negative resistance.
(2) Some means of balancing out the steady plate current, so that the 100 μamp. meter on which the small current change is read will not read the total plate current, but only the small change.
(3) A protective device which will prevent large changes of plate current, which will occur while the circuit is being adjusted, from overloading and damaging the sensitive meter.
(4) A scheme for adding small increments of plate, and of measuring these increments.
(5) A switching arrangement which will disconnect all batteries and prevent them from discharging while the instrument is not in use.
(6) Bypassing between the "cold" end of the plate circuit and the cathode of the valve so that all R.F. is confined solely to the tuned circuit.
(7) A convenient means of connecting tuned circuits to the plate circuit with as little lead as possible.

All these features are incorporated in the main circuit diagram. The panels at the bottom of this diagram represent terminal strips, one of which is used to terminate the wiring from the circuit to the batteries and the other, for the batteries themselves, together with the 2.5v. heater transformer for he 224 that is used as the dynatron valve. This method of drawing has been used to simplify the wiring up process, since there are six different battery units, and a purely theoretical diagram makes it necessary to do a considerable amount of sorting out of battery connections. Since batteries are used, and not a power supply from the mains, it is essential to have things arranged so that it is easy to change batteries when this becomes necessary. With an arrangement like the one shown, it is a simple matter to have a series of tagged leads, two for each battery unit, so that there is no need to make cross-connections at battery terminals. This removes a fruitful source of errors in connecting up new batteries. It will be noticed that the circuit is earthed at one point only, and is built otherwise completely insulated from the metal chassis. This helps to give a satisfactory R.F. circuit, without any ground loops which might cause losses that could be attributed wrongly to the circuit under test. It also enables the circuit to be grounded at an unusual point, so that there is very little risk of the operator getting a shock when connecting or disconnecting a test circuit from the terminals. Contrary to the belief of many, 90 volts of good battery can give one a very nasty nip, not at all to be despised. The circuit shows that both the

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screen, and the "cold" end of the test circuit are carefully bypassed to the cathode of the valve. Because of this, R.F. is excluded from the whole of the measuring circuit, which becomes, in practice as well as in principle, a purely D.C. affair. This, incidentally, is one of the advantages of the method, in that all measuring is done with D.C. instruments, which are inherently more accurate than any A.C. meters of reasonable price. Double bypassing is used, because the 0.1 μf. condensers will not be completely effective at high radio frequencies, which are then taken care of by the small mica condensers, which have considerably less inductance than ordinary paper tubulars.

THE CIRCUIT IN DETAIL

It might simplify matters if it is stated at the outset that the switches S_1 to S_5 are all on two double-pole three-position wafers, and are used for switching the batteries out of circuit when the instrument is out of use, or on "stand-by," when all that is left on is the heater of the valve. In the diagram, all are shown in the "on" position.

First of all, at the left of the diagram, is the grid circuit. This consists of a 10k. grid stopper in series with the grid lead, to prevent the occurrence of parasitic oscillations, and a 500-ohm potentiometer, one side of which is returned to the cathode of the valve. A 9-volt C battery is connected across the potentiometer, and this is sufficient to bias the valve to cut-off, or very close to it. A good wire-wound potentiometer must be used here, and it must have a large- easily-moving adjusting knob, so that very smooth and fine adjustment of grid bias can be made. Since the actual value of the bias is not of immediate concern, there is no necessity to meter the grid bias. Next to the right we have the heater transformer. One side of the heater is connected to the cathode, and switching is performed in the primary circuit of the transformer in order to avoid switching the heavy heater current with the light contacts of a wafer switch. It will be noted that the heater is left running on positions 2 and 3 of the switch, the former being the stand-by position, and the latter, of course, the measuring position. Position 1 is "Off." Next along the line we have two 45-volt B batteries in series. These give 90 volts for the screen, and 45 for the plate of the valve. These batteries are switched in their common negative lead, so that it will not be possible to purposely leave the screen

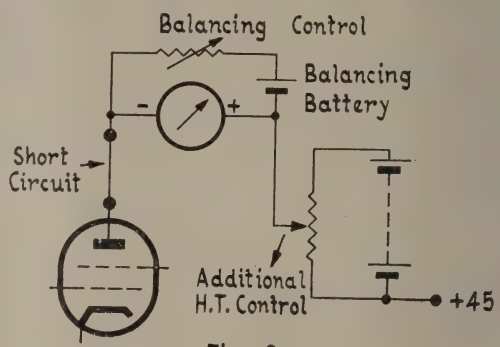


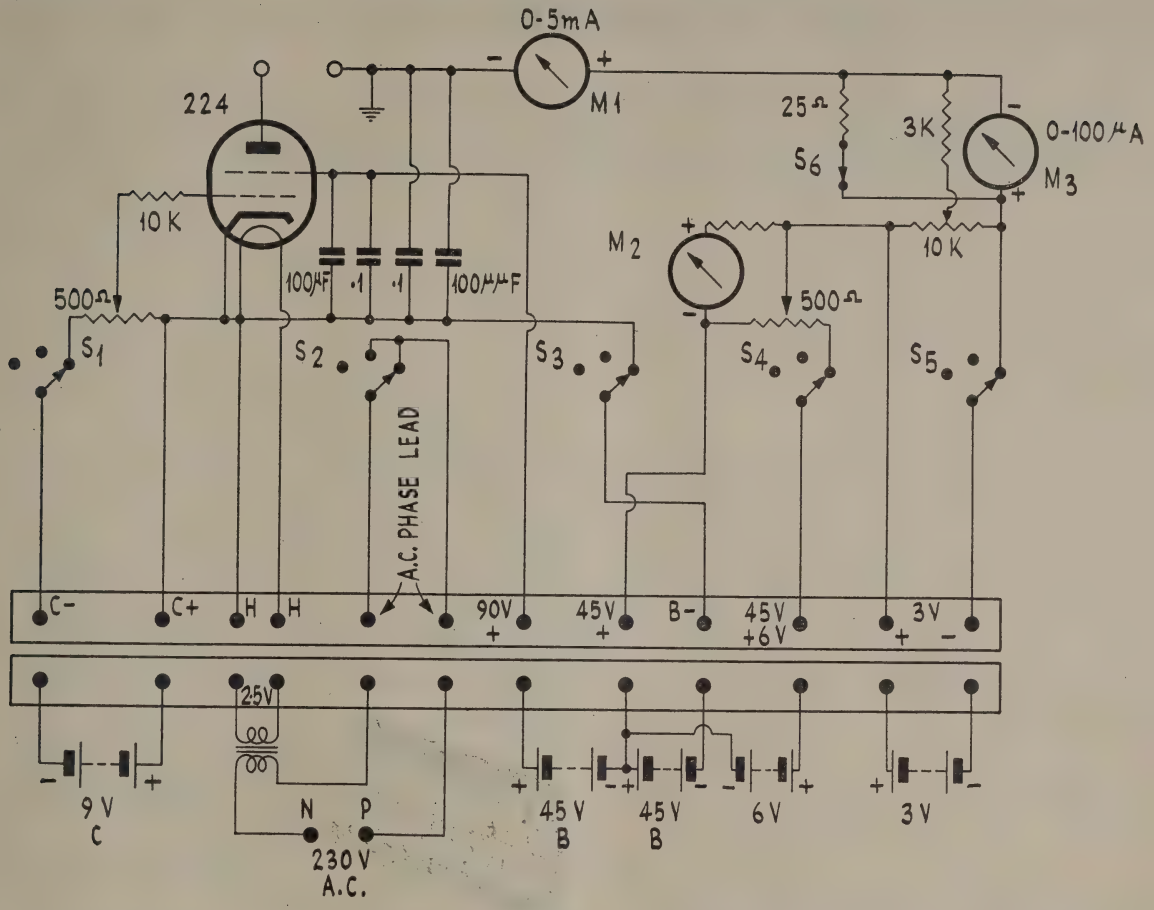
Fig. 3

voltage on without plate voltage applied at the same time, and also to avoid the necessity for a further switch section. So far the circuit is very simple, and the only complication comes in the plate circuit. Here, we have two additional small batteries. The first ,of six volts, is used to provide the controllable amount of additional plate voltage, while the three-volt battery is used as a bucking, or balancing battery for balancing out the majority of the plate current from the 100 μamp. meter.

In order to simplify things, this part of the circuit has been illustrated separately in Fig. 3.

The terminals to which the tuned circuit is attached are shown short-circuited, because the circuit should be removed, and a shorting bar substituted before the actual measurement of the negative resistance is made. The meter shown is the sensitive 100 μamp movement, and across it is connected a battery in series with a rheostat. The polarity of the battery is such as to deflect the pointer backwards, so that a deflection caused by the plate current is cancelled out. Then, by adjusting the rheostat, the current through the meter can be reduced to a value that allows the meter to read approximately half-scale. In this condition, it is possible to read directly a small change in plate current, such as the 10 μamps we are interested in.

The remainder of the circuit is the arrangement for adding small increments of plate voltage. A small battery, separate from and additional to the 45-volt plate section of the H.T. battery, is connected across a low-resistance potentiometer, and the moving arm of the latter is taken off to the plate circuit as the final supply lead. The negative terminal of the battery is connected to the 45-volt tap on the H.T. battery. With this arrangement, the potentiometer is able to provide any amount of additional voltage, from zero up to the full voltage of the extra battery. The potentiometer introduces a



small extra resistance into the plate circuit, but this is quite negligible in comparison with the actual negative plate resistance, and in no way affects the results. Not shown on Fig. 3 is the method of measuring the additional plate voltage, but this consists merely in connecting a voltmeter across the lower portion of the potentiometer, from the 45-volt battery tap to the moving arm. Since this is a permanent connection, any effect on the voltage caused by shunting the voltmeter across the voltage source is of no consequence, since at all times the voltmeter reads the actual voltage added. For this reason, too, it is not advisable to try and use an external voltmeter in this position. An external meter could be used, but would defeat its own object, since it could not be used for any other purpose in the circuit by changing its position.

Coming back to the actual circuit, we find that the arrangement used is slightly different from that shown on Fig. 3, for the balancing.

The three-volt balancing battery is connected across a 10k. potentiometer, providing a continuously variable source of voltage, rather than a fixed source with a variable series resistor. Then, a fixed series resistor of 3000 ohms is used between the moving arm of the potentiometer and the negative terminal of the meter. The reason for this circuit change is to be found in the protective device that is used to prevent the meter from being overloaded. This was not shown on Fig. 3, and consists of the 25-ohm resistor, in series with the switch, S_6. This switch is either a normally closed push-button, opening when pressed, and returning automatically to the closed position when released, or a toggle type, with a similar action, *i.e.*, one which has to be held in the operated position, and springs back if released. The 25-ohm resistor is simply a shunt, which reduces the sensitivity of the meter except when the push-button is operated. Thus, unbalance currents up to the full plate current of the valve can be passed through the meter circuit without damage, as long as the button is not pressed. The procedure for balancing the meter is to obtain a balance with the 10k. potentiometer, the shunt being still in circuit. Then, when the button is pressed, there will be only a small current left flowing through the meter, and the balance control can now be used to make the meter read at any convenient position on its scale. It is best not to balance out the current completely, but to allow about half-scale deflection, preferably with the pointer set exactly to one of the major scale divisions. The actual balancing circuit used has the advantage that, unlike the simple one of Fig. 3, the operation of the protective shunt does not have an appreciable effect on the balance position as it is cut in and out. It also keeps a large resistance always in series with the meter, so that there cannot be any appreciable error in reading the plate current change, owing to

(Continued on Page 48)

THE NEW ZEALAND ELECTRONICS INSTITUTE (Inc.) NEWSLETTER

GENERAL

As there has been considerable Branch activity during the recent period it has been decided to devote the Institute newsletter this month to reports on Branch activities.

CHRISTCHURCH

As we go to press advice has been received from the Chriscthurch Branch that there is to be a trip to the N.Z.B.S. transmitting site at Gebbies Pass, where the Supervising Technician, Mr. H. B. Fletcher, assisted by his staff, will explain and demonstrate the recently-installed transmitters and associate antennae. Wives of members had been invited and hot water was to have been available, hence the trip was combining social activity with educational work.

DUNEDIN

The February meeting was opened by Mr. Symmons and after discussing routine business the meeting adjourned to hear a lecture by Mr. W. G. Collett, B.Sc., on electronic switches. The cathode ray tube was first explained by Mr. Collett and after careful explanations of its action Mr. Collett then explained the principles of the Cossor double beam tube and its applications. The ingenious manner in which the electron beam is split up to produce the double ray tube was also explained and in detail the applications and limitation of this tube in use. Complete circuits for the use of triggered electronic switches for these tubes were explained and a demonstration given of a tube and its circuits built up by Mr. Collett. At the conclusion, a hearty vote of thanks was moved by Mr. Symmons, who also proposed a vote of thanks to Mr. Burton, Principal of the College, for his consideration in allowing the use of the College for this lecture.

WELLINGTON

The monthly general meeting was held in the Conference Room, Air Department Building, Bunny Street, on Wednesday, 21st February. The meeting took the form of a film evening as the Committee had been fortunate in procuring two excellent films—"Atomic Physics": This was a full-scale review of the whole field of atomic energy up to 1948 and is of 100 minutes' duration. The second film entitled "Look and Listen" was of considerable interest, illustrating the studio technique of producing a television programme.

Branch News:

We welcome back S/Ldr. A. L. Partelow (A.I.) R.N.Z.A.F., from service in the U.K.

Also we welcome to our branch Mr. A. D. Notman (S) who has been transferred from the Dunedin branch.

Accessions to Branch Library:

Publications received up to December, 1950:

Radio and Electronics, Vol. 5, Nos. 8, 9, 10, 11, (I.E. Oct., Nov., Dec., 1950).

Philips "Electronic Application Bulletin" Vol. II, No. 6/7.

Philips Experimenter Nos. 32, 33, 34, 35, and 36.

Philips Bulletin: August/October, 1950, and November/December, 1950.

Television

Wellington members were fortunate in having the opportunity of attending the first official demonstration to be held in Wellington. The demonstration was arranged by Amalgamated Wireless (A'asia) Ltd., in conjunction with the New Zealand Broadcasting Service, and was held in the Waring Taylor Street studios of Station 2YA. The camera was located in the small studio, and four viewing units of 8 in. size were placed in the large studio. In addition, a 16 in. viewing unit was available in an adjacent room. The units were linked with the camera by co-axial cable, as it was unnecessary to use radio transmission for the purpose of the demonstration over so short a distance. Six sessions per day were held, and 150 people were accommodated at each session.

The sessions lasted for approximately three-quarters of an hour, and a special programme was arranged by the N.Z.B.S. to include many well-known Wellington radio and other personalities.

After the showing, members of the New Zealand Electronics Institute were invited into the camera studio and were able to inspect the camera, and discuss the technical details with the engineers. Very favourable comments were passed on the excellent clarity of the picture reproduction. Members were very appreciative of being able to see the demonstration as only a limited number of people could be accommodated during the four days.

The technical appetite of members has now been whetted and all are looking forward to the early introduction of a regular television service in New Zealand.

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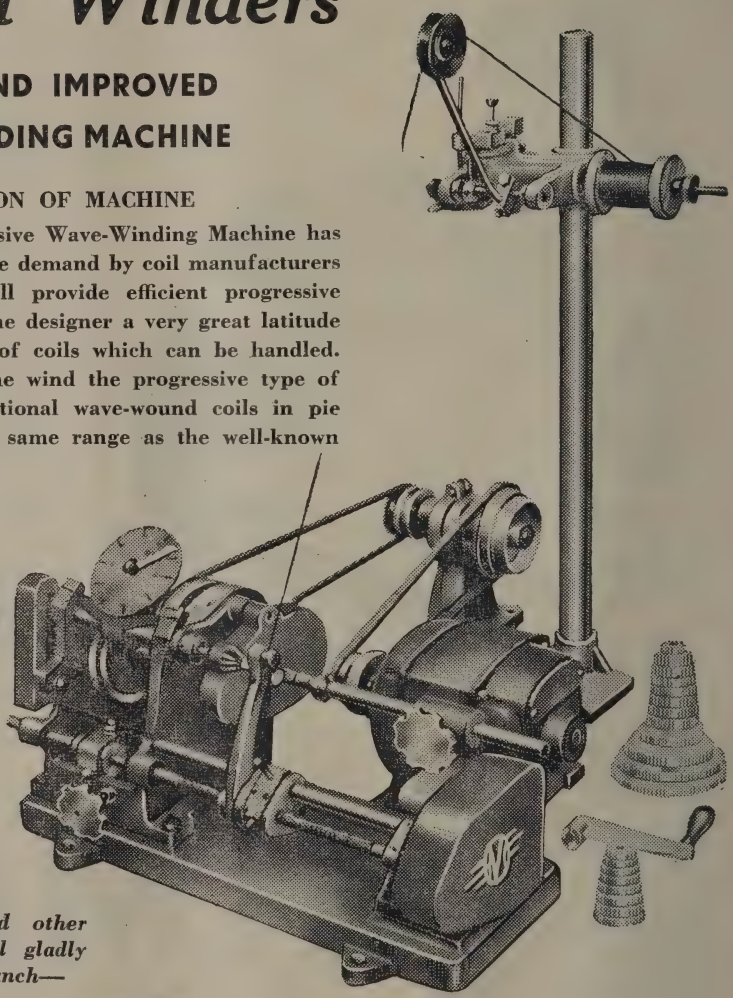

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TUBE DATA: Some Lesser-known but Useful Valve Types —Part II

THE 955 V.H.F. ACORN TRIODE

It is quite a long time since the "acorn" valves were first produced in an attempt to overcome some of the inherent difficulties of making conventional valves work at ever-increasing frequencies. The acorns were very successful, and have retained their usefulness in spite of the later development of the miniature series of valves. Their small dimensions, reduced inter-electrode capacities, and reduced input and output damping have all contributed to their success, and they are useful at frequencies higher than 300 mc/sec. Initially, their price was rather against them, since they cost about twice as much as the conventional valves of the time, but now, when there are considerable numbers of these tubes available from war surplus at mere token prices, there has been a reawakened interest in them on the part of amateurs, especially. They can be used even as high as the 420 mc/sec. amateur band, and this journal has already described equipment for this band built round their excellent high-frequency performance. Perhaps the most useful of the acorns is the 955, the triode of the series. It has a 6.3 volt 150 ma. heater, and is especially suited for application as an oscillator in receivers and low-powered transmitting applications. Another disadvantage of the acorns in the past was that their full curves and characteristics were not made available by the makers in their normal data books, the acorns appearing only in the special loose-leaf data books that many enthusiasts do not possess.

Many readers will, therefore, be glad to have the full and complete data on these useful tubes. Since they are now so reasonable in price, one can readily imagine uses for them that would have been definitely uneconomic at one time. For instance, for any receiver above the 30 mc/sec. mark, it would be a very wise step to install an acorn 955 as the local oscillator, since their excellent V.H.F. characteristics make it possible to build a lively and efficient circuit that would be hard to equal, even with modern miniatures. For use in circuits where the tuning elements are long lines, the 955 is admirably suited, and its unconventional construction makes it rather more suitable in this respect than the conventional miniature. Below will be found tabulated characteristics, typical circuits, and characteristic curves for the 955.

DETECTOR, AMPLIFIER, OSCILLATOR

ACORN TYPE

Especially for wavelengths between 0.5 meter and 5 meters

Heater	Coated Unipotential Cathode	
Voltage	6.3	a-c or d-c volts
Current	0.15	amp.
Direct Interelectrode Capacitances:●		
Grid to Plate	1.4	μμf
Grid to Cathode	1.0	μμf
Plate to Cathode	0.6	μμf
Overall Length		1-7/32" ± 5/32"
Overall Diameter		1-3/32" ± 1/16"
Bulb }	See Outline in	T-4½
Base }	GENERAL SECTION	Small Radial 5-Pin ←
Pin 1 - Heater		Pin 4 - Heater
Pin 2 - Plate		Pin 5 - Cathode
Pin 3 - Grid		
RCA Socket		Stock No. 9925
Mounting Position		Any

Short Part of Bulb: Bottom

BOTTOM VIEW (5BC)

Maximum Ratings Are Design-Center Values

A-F AMPLIFIER

D-C Plate Voltage	250 max.	volts
Plate Dissipation	1.6 max.	watts
D-C Heater-Cathode Potential	80 max.	volts ←

Typical Operation and Characteristics — Class A_1 Amplifier:

D-C Plate Voltage	90	135	180	250	volts
D-C Grid Voltage*	-2.5	-3.75	-5	-7	volts
Amplification Factor	25	25	25	25	
Plate Resistance	14700	13200	12500	11400	ohms
Transconductance	1700	1900	2000	2200	μmhos
D-C Plate Current	2.5	3.5	4.5	6.3	ma.
Load Resistance	-	-	20000	-	ohms
Second Harmonic Dist.	-	-	5	-	%
Power Output	-	-	135	-	mw

Typical Operation with Resistance-Coupling:

Plate-Supply Voltage○	180 volts
D-C Grid Voltage*	-3.5 volts
Load Resistance	250000 ohms
Plate Current	0.42 ma.
Second Harmonic Distortion	5 %
Voltage Output	45 RMS volts
Voltage Gain	20 approx.

R-F POWER AMPLIFIER & OSCILLATOR — Class C

Plate Modulated or C.W.

D-C Plate Voltage	180 max.	volts
D-C Plate Current	8 max.	ma.
D-C Grid Current	2 max.	ma.
D-C Heater-Cathode Potential	80 max.	volts ←
Typical Operation:		
D-C Plate Voltage	180	volts
D-C Grid Voltage	-35 approx.	volts
D-C Plate Current	7	ma.

(continued from preceding page)

D-C Grid Current	1.5 approx.	ma.
Power Output**	0.5 approx.	watt

Typical Operation:	DETECTOR *Biased*	*Grid-Leak*	
Plate-Supply Voltage○	180	45	volts
Grid Voltage	-7 approx.	Grid Return to Cathode	volts
Load Resistance	0.25	-	megohm
Plate Current	Adjusted to 0.2 ma. approx. with no input signal.	-	ma.
Cathode Resistor	50000 approx.	-	ohms
Grid Leak	-	1 to 5	megohms
Grid Condenser	-	0.00025	μf

● With no external shield.

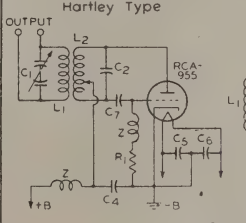
* Under maximum rated conditions, the resistance in the grid circuit should not exceed 0.1 megohm with fixed bias, or 0.5 megohm with cathode bias.

○ This is a plate-supply voltage value. The voltage effective at plate will be plate-supply voltage minus the voltage drop in load caused by plate current.

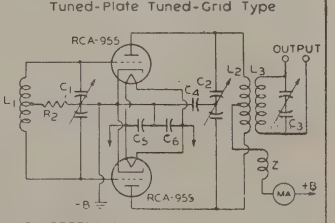
** At 5 meters. Only moderate reduction in this value will be found for wavelengths as low as 1 meter. Below 1 meter, the power output decreases as the wavelength is decreased.

R-F grounding by means of condensers placed close to the tube pins is required if the full capabilities of the 955 for ultra-high-frequency uses are to be obtained.

U-H-F OSCILLATOR
Hartley Type



PUSH-PULL U-H-F OSCILLATOR
Tuned-Plate Tuned-Grid Type



L_1C_1, L_2C_2, L_3C_3 = DEPEND ON FREQUENCY RANGE DESIRED

92CM-6558

C_4, C_5, C_6 = 100 μμf

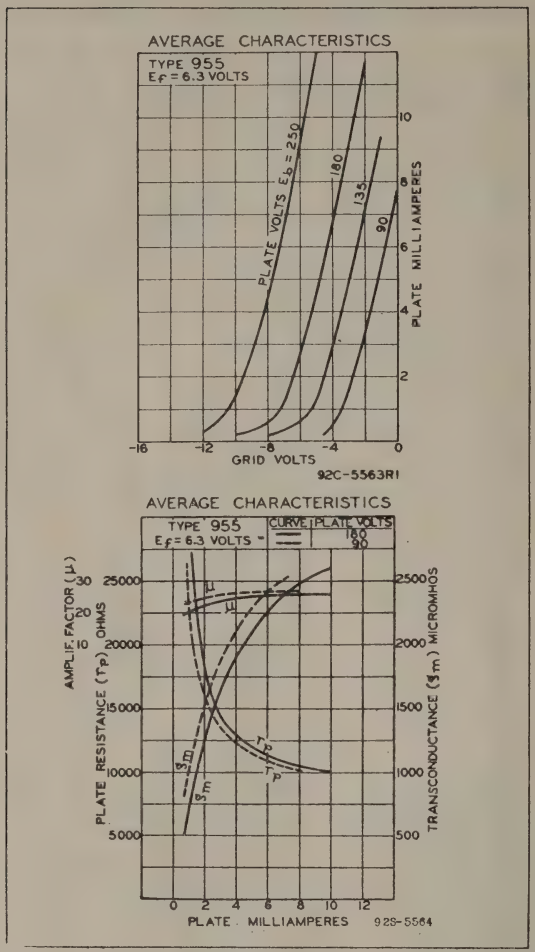
C_7 = 50 μμf

R_1 = 20000 TO 25000 OHMS, ½ WATT

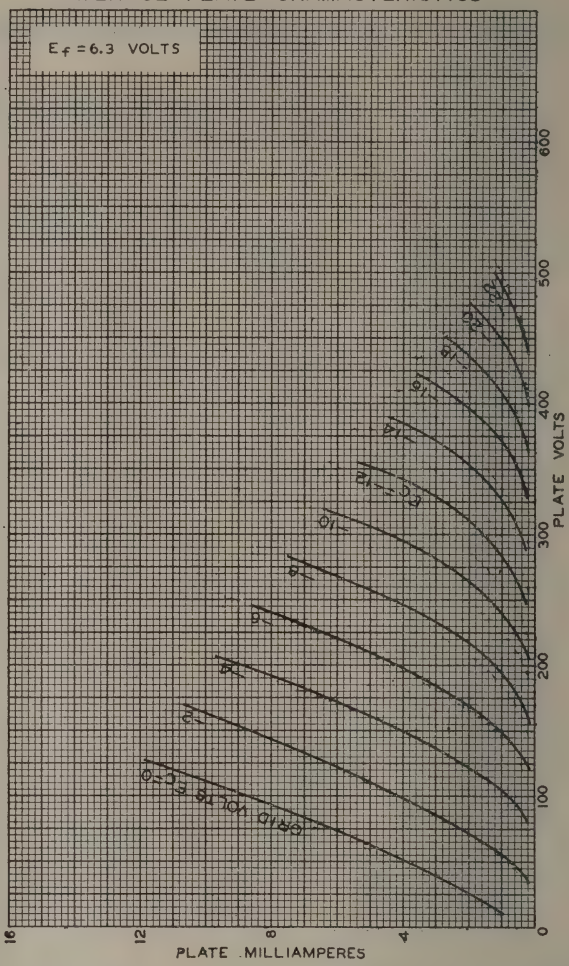
R_2 = 10000 TO 12500 OHMS, ½ WATT

Z = R-F CHOKE

CHARACTERISTICS CURVES

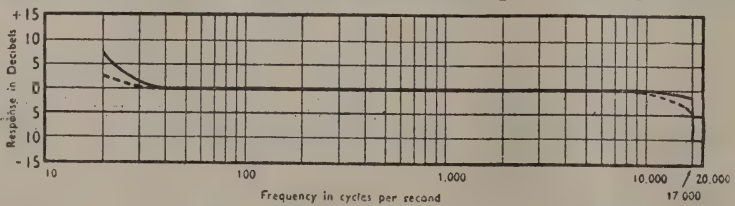


AVERAGE PLATE CHARACTERISTICS



BRIERLEY PICK-UPS

The JB/P/R Pick-up has been designed with the sole object of obtaining as realistic reproduction from gramophone records as possible with negligible wear of records. The real test is a listening test and not specification data, and, provided the recording and the rest of the equipment are of a sufficiently high standard, the results obtained are such that it can be difficult to realize that one is not listening to an original performance.



Dotted Line refers to Ribbon Pick-up Full Line refers to Armature Pick-up
Response Curves include Coupling Transformers
Correction has been made for low-frequency Attenuation in Test Record

RADIO REPAIRS LIMITED.
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Specification of Brierley Ribbon

Point: 80 times longer wearing than sapphire, ground and polished to an accuracy of 0.00002 in.
Total Mass of Moving Parts: 17 milligrams.
Effective Mass at the Point of Moving Parts: 4 to 5 milligrams.
Downward Pressure on Record: one-eight of an ounce.
Magnet Alloy: Alcomax.
Low-frequency Resonance: 5 c/s. (approximate).
Output Voltage: 0.0075 to 0.01v. R.M.S. (measured across secondary of Coupling Transformer with ¼ megohm load).
No measurable upper resonance.
Vertical compliance.

Provision is made for vertical motion of the point to minimize so far as possible defects due to the "pinch" effect. The Pick-up is quite robust, and there is no possibility of damage occurring from normal use; accidental dropping on to the record surface will not cause any damage.

WRITE FOR PAMPHLETS

THE "RADIO AND ELECTRONICS" ABSTRACT SERVICE

ANTENNAE AND TRANSMISSION LINES

From the diversity of TV aerials now developed the amateur will be seeking a simple and practical type whose functions are not too difficult to understand. The "3 over 3" is here explained which has increased gain and a low angle of radiation.

—*Radio and Hobbies* (Aust.), February, 1951, p. 33.

The connections between aerial and receiver do not usually receive the attention they deserve, and need for matching is often necessary. Balanced and unbalanced feeders are here discussed.

—*Wireless World* (Eng.), December, 1950, p. 426.

AUDIO EQUIPMENT AND DESIGN

A further description is given, with circuit diagrams, of the Flewelling type audio amplifier, which has caused a stir in audio engineering circles. Flewelling claims that the bass end is the foundation of music, and his circuitry is distinguished by the large coupling condensers for bass response.

—*Ibid*, p. 15.

Many music lovers still use thorn needles, and under proper conditions there is no less of useful "top", and wear is much reduced. Certain advantages and disadvantages are discussed.

—*Wireless World* (Eng.), December, 1950, p. 450.

Sidelights on loudspeaker cabinet design, continued from an earlier issue. The theory of motional impedance and acoustic cabinet systems are explained.

—*Ibid*, p. 436.

Most of wire and tape recorders today are equipped with amplifiers of dual type, *i.e.*, one amplifier for recording and playback. Here is a two-channel amplifier designed on one chassis to meet the disadvantages of the dual type.

—*Radio and TV. News* (U.S.A.), November, 1950, p. 45.

By what standards does one judge audio quality? Is it to be "pleasant and mellow" or embracing the sometimes strident and less pleasing tones of the music of the instruments. The test is faithfulness of reproduction, here discussed.

—*Ibid*, p. 44.

An article on how to recognize various types of hum in audio circuits, and methods of eliminating it.

—*Ibid*, p. 55.

Experiments for the production of critical high-quality speakers unlimited by cost, have resulted in the "triaxial" loudspeaker with three channels in the one instrument.

—*Ibid*, p. 66.

How far can a loudspeaker be mismatched to its valve without too unsatisfactory results. Under certain conditions, mismatching up to several hundred per cent. can be tolerated. It depends on the load characteristic of the amplifier output stage.

—*Audio Engineering* (U.S.A.), Jan. 1951, p. 17.

ELECTRONIC DEVICES

Experiments made at St. Dunstan's on the electronic guiding aids for the blind, use light scanning of the immediate surroundings with an acoustic device registering in the form of clicks. The instruments are interesting, but the conclusions throw doubt on the permanent usefulness of any device for the blind which can compete with intuition and training.

—*Electronic Engineering* (Eng.), Jan. 1951, p. 2.

Electrically operated high vacuum gauges can be divided into two distinct groups, those using a thermocouple or the like, and discharge tubes and ionization gauges. These two types are here distinguished.

—*Ibid*, p. 30.

MATHEMATICS

The behaviour of cathode followers as matching devices is well known. The question here treated is that of cathode followers in relation to pulse responses.

—*Wireless Engineer* (Eng.), December, 1950, p. 289.

Fixed and variable attenuators are used in communication networks to smooth outimpedance irregularities. Methods of calculating the impedances, in the form of monographs, are given.

—*Audio Engineering* (U.S.A.), January, 1951, p. 20.

MEASUREMENTS AND TEST GEAR

An improved and inexpensive type of simple valvemeter with good zero stability is described.

—*Wireless World* (Eng.), December, 1950, p. 430.

It would seem that the perfect audio test generator should have been completed years ago, but the wide tuning requirements make the design difficult. An R.C. beat frequency oscillator is here described, which is an improvement on earlier types.

—*Radio and Television News* (U.S.A.), Nov. 1950, p. 69.

Here is another article on the use of square-wave testing techniques for checking audio amplifiers.

—*Ibid*, p. 83.

Field-strength meters of the crystal diode type are inclined to fall down in not being on a logarithmic scale and are not sufficiently sensitive. An easily portable type to overcome these difficulties is described.

—*Q.S.T.* (U.S.A.), January, 1951, p. 24.

The design is given of a wide-range test oscillator, another RC wide-range type with undistorted waveform, good output voltage and good frequency stability.

—*Ibid*, p. 29.

Simplified equipment allows relatively inexperienced personnel to make extremely accurate measurements of frequencies up to 10 mc/sec.

—*Electronics* (U.S.A.), February, 1951, p. 97.

A simple pulse generator with a fixed repetition rate is described the pulses having a time rise of 0.8 microseconds. The circuit can be built from a few normal laboratory components and requires no rectifier unit.

—*Wireless Engineer* (Eng.), December, 1950, p. 285.

A design of bridge and detector circuits used in production lines for automatic measurements of inductance, capacitance, and effective resistance. A graphical method of determining phase and amplitude of bridge unbalance voltage is included.

—*Electronics* (U.S.A.), February, 1951, p. 110.

MICROWAVE TECHNIQUES

V.H.F. for the amateur is here discussed with the advantages to those operators who move into the higher frequencies. Notes on the practical requirements are given in outline.

—*Q.S.T.* (U.S.A.) January, 1951, p. 40.

RECEIVERS

A case is made out for the home-made DXer, as manufacturers cannot meet the requirements of everybody. Some varied types of layout to suit individual requirements are given.

—*Q.S.T.* (U.S.A.), January, 1951, p. 20.

Construction details are given of an effective 2-metre receiver which is popular with amateurs in Australia. Useful points are added to the application of new miniature tubes and disposal components of V.H.F. gear.

—*Radio and Hobbies* (Aust.), February, 1951, p. 24.

A discussion on methods of measuring bandwidth in F.M. receivers to ensure optimum fidelity. Testing is done with a frequency modulated signal generator, and an oscilloscope.

—*Audio Engineering* (U.S.A.),, January, 1951, p. 18.

TELEVISION

Colour television—the frequency interlace system (or frequency multiplexing) is described. A simplified outline of the arrangement is given.

—*Wireless World* (Eng.), December, 1950, p. 443.

Progress in the dot sequential colour TV systems is given and some details of the new tricolour tube with three electron guns and special phospor.

—*Electronics* (U.S.A.), February, 1951, p. 80.

Further notes on colour television relating to band sharing and mixed high-frequency transmission of the dot sequential system.

—*Ibid*, p. 92.

Television continues to expand in the realm of industry for the observation of things remote from the human eye; coal mining, the automobile industry, supervising remote control, etc.

—*Electronic Engineering* (Eng.), Jan., 1951, p. 8.

MISCELLANEOUS

Ultrasonic energy—theoretical consideration—wave transformation-velocity—velocity calculations, reflection of ultrasonic waves, etc., and the construction of generators.

—*Electronic Engineering* (Eng.), January, 1951, p. 14.

Those whom the theory of polarized light may have puzzled, will find enlightenment in this simple article on the principles involved.

—*Radio and Hobbies* (Aust.), Feb., 1951, p. 12.

Binders for "Radio and Electronics"

Our stocks have been exhausted but further supplies will be coming to hand in May. We very much regret to advise subscribers that printer's charges for further supplies have so risen that we have to raise our prices too, but so as to keep the cost of single binders within reason we have been forced to discontinue discounts on quantity copies.

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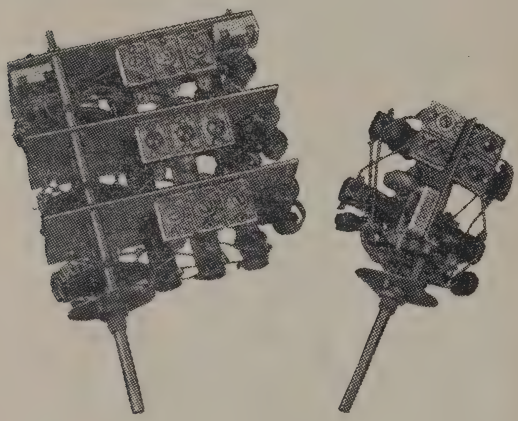

HIGH "Q" COILS CYLINDER DUST CORES ON B.C. BAND ALIGNED IN ACTUAL RECEIVER MAKES A COMMERCIAL JOB OF A HOME-BUILT RECEIVER

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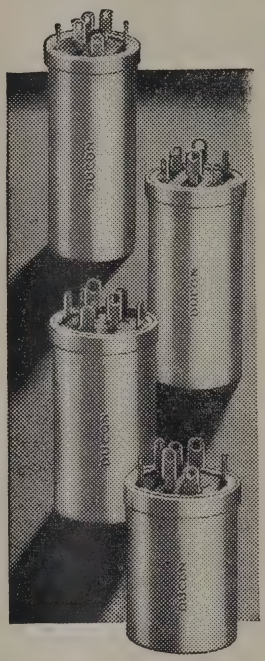
MULTI'S



Ducon Multi-section 1⅛ in. Dry Electrolytic Capacitors may now be purchased in single, dual, triple, and quadruple assembly. They are available in an extensive variety of capacity and voltage rating combinations.

These Multi-section units are especially suitable for use with compact assemblies where space is limited.

Designed to mount directly to the chassis by twisting the mounting ears provided. They may also be mounted by means of steel or bakelite plates as illustrated below.

The splendid performance of this new Ducon Multi-section unit capacitor is one more illustration of Ducon's 17 years of leadership in the capacitor field.

Specify Ducon for all exacting capacitor applications.

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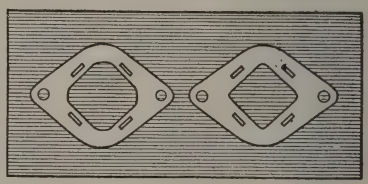

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SHOES and SHIPS

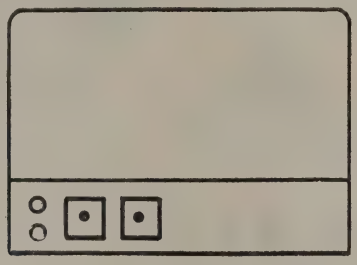
"The time has come," the Walrus said,
"To talk of many things. . . ."

By Special Arrangement with the Walrus

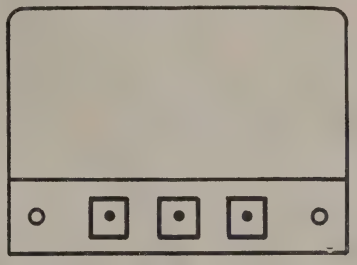
SOME HINTS ON APPEARANCE

Most servicemen and constructors have at some time or other built amplifiers or radio equipment which calls for a panel bearing the necessary controls such as "volume," "bass," "treble," etc. This in itself does not present a great problem and probably the job turned out successfully to the complete satisfaction of the builder. However, before long one will see a professionally built instrument designed to do the same job and that niggling little demon rears its head and says "why doesn't mine look like that."

The answer is really obvious and can be summed up thus—attention to detail and balanced layout. For instance, when fitting graduated gain plates over volume controls don't just put the plate on and screw up the nut. The chances are that the plate will twist at some odd angle and will very likely get scored by the spanner and almost certainly by the nut. The proper procedure is to put a nut on the potentiometer before inserting it in the panel, then put on the gain plate and screw the top nut down finger tight. The plate may then be straightened up, if necessary with a square, and then tighten the rear nut behind the panel. Its so simple but so much more effective! In cases where it is not possible on account of the chassis shape to get at the rear nut put a volume control washer between the gain plate and the top nut and hold the plate firmly in position while tightening. Having got this far it will probably be necessary to take it all to pieces again since the usual fault will occur! When the pressure on the nut is increased it draws the centre of the plate in tight against the panels and pulls the outer edges away. This, of course, is unworthy of that "super job" so a little careful pressure with the fingers on the plate to give it a slightly convex shape before fitting makes all the difference since the locking nut now presses the outer edge of the plate down hard on the panel. Simple but just another worthwhile point!



No. 1



No. 2

In cases where small screws are used to fix escutcheons and name plates in position a good wrinkle to enhance the appearance of your product is to line all the screw heads with the slots for the screwdriver all facing the same way. Yes, it does take a little longer but you are gaining that professional touch.

Name plates and potentiometer plates if cut square in a guillotine can generally be improved by running a file over the corners to round them off.

Now for balanced layout. Practically everything in radio is a compromise, very rarely can a man say he has constructed something which he considers is perfect. Somewhere or other he has had to defer to availability of material or for convenience sake include a piece of circuitry he would have preferred to leave out. If, then, we have to do this we can surely compromise a little with what is good in theory for the sake of gaining a lot in eye appeal. Therefore, instead of putting that mike gain control as close as possible to the mike pre-amplifier (good practice theoretically) group it nicely in the centre of the panel with the other controls. Provided it is carefully done and the leads are extended through shielding braid, very little need be sacrificed. Hum is much more likely to be incurred through indiscriminate earthing of grid leaks, bias resistors, and condensers, etc. Our diagram illustrates what is probably good for electrical convenience but what a horror it looks against our balanced amplifier which will more than likely operate just as well.

In the case where an odd number of controls makes grouping difficult, add something to create balance. For example, if amplifier no. 2 had only a phonograph input, volume control, bass and treble controls and no mike input add either a mains toggle switch or jewel lamp indicator to even things up. And now just an odd note on an awkward point. When you have to mark out a new cabinet for a radio a surefire way of drilling the front panel correctly is to put a small blob of white paint on the centre of each control shaft (volume, tuning, tone, etc.), and slide the set into the back of the cabinet pushing it up against the front panel hard. Nice clear marks should result. If the shafts are of different lengths drill out the marks made by the longest ones first then push the chassis in again for the shorter ones. Having got the controls positioned the dial cut-out is easily measured off from them with a ruler. This method is guaranteed to take the tremble from your hand when attacking that beautiful polished panel with your drill and saw.

When there's a better switch
ARCOLECTRIC will make it
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"For want of a Radiotron!"

For want of a Radiotron a radio is silenced! For want of a Radiotron an expensive piece of electronic equipment may be idle! For want of a Radiotron urgent communications can be held up.

Radiotron Valves are seldom found wanting. And Radiotron replacements when needed are quickly obtainable. Firstly, through the network of Radiotron dealers throughout New Zealand. Secondly, through the eight branches of the N.E.E.Co. as distributors. Lastly and most importantly, through the A.W.V. Radiotron factory only eight aero-hours away in Sydney.

For dependable service, install Radiotrons as first equipment. For super service, always revalve with Radiotrons.

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New Zealand Distributors:

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TRADE WINDS

N.Z. Radio Traders' Federation

The Executive, under Chairman J. Fairclough, have been active and many important phases of the industry which have been under consideration for some time, have now been finalized.

Bona Fide Radio Dealers' List

This list is now to be printed and made available to all members of the Federation. The aim and object of this Register of Dealers is to endeavour to eliminate some of the unfair practices of unauthorized persons and to provide an authoritative list of dealers for the information of all concerned.

Trade-in Booklet

This booklet is now in the hands of the printers and a copy will be issued to all radio dealers, whether members of the Federation or not. The distribution of subsequent issues may be confined to members only. It is proposed to keep the information up to date with a new issue yearly.

Badges.

After a lnog period of discussion as to the form this should take, an official badge is now available and has been issued. It has been issued to all radio dealers who are members of the Federation. It should serve to instil public confidence in the choice of servicemen and dealers. Advertising by the Federation could go a long way towards educating the public to purchase from dealers showing the badge in their windows and it would become quickly known to the public that sales and service are available at a reasonable cost. The badge will be renewed yearly.

Condensers

Discussions have been taking place for some time on the subject of condenser imports as against protection of the local industry. Talks with the Board of Trade are expected to provide a solution satisfactory to all parties. Mr. D. Billing recently lead a deputation to the Board of Trade, when the traders' point of view was fully put forward. A firm decision has not yet been promulgated by the Board of Trade.

Dry Batteries

It has been reported from some parts of New Zealand that there is a shortage of batteries for portable radios and hearing aids. This matter is being investigated by the Federation and the Board of Trade is to be approached with a view to having import licences granted to assist in the supply.

Rules.

Auckland Association has submitted a new set of rules for the consideration of the Federation. The existing rules have not been revised for some time and the intention is to bring them up to date. The proposals are being submitted to all member associations for their views.

Annual Conference

It has been decided that this will be held at Chateau Tongariro and Auckland Association is in charge of the necessary arrangements. Tentative dates are 26th–29th April, 1951.

New Award for Radio Trade

An agreement was reached in Conciliation Council between the employees' and employers' assessors. The results of this hearing appear elsewhere in this magazine and a new award can be anticipated when the Court of Arbitration has completed its deliberations. The agreement in so far as it relates to wages will probably be back-dated to the date on which the hearing in Conciliation Council commenced (15th February, 1951).

NORTH ISLAND ELECTRICAL WORKERS (RADIO SECTION) DISPUTE

The information given hereunder represents the basis of agreement between the parties in Conciliation Council and does not become effective until ratified by the Court of Arbitration.

Attention should, however, be drawn to the fact (for the benefit of employers) that wage provisions are normally made retrospective to the date on which the Conciliation Council first commenced (in this case 15th February, 1951).

With the exception of the inclusion of "Ducon (N.Z.) Ltd." in the list of parties, complete agreement was reached at the Conciliation Council which commenced on 15th February, 1951, and documents have been forwarded to the Court of Arbitration for ratification.

PARTICULARS

Clause 1—*Industry to which Award Applies.*

Subclause (a) was extended by adding after the word "frequencies" the words "and other communication and high frequency equipment" and by adding to the end of the subclause the words "and the assembly of the units."

Clause 2.—Definitions.

A new subclause was added. "A foreman is a worker placed in charge of six or more adult workers exclusive of any worker paid in accordance with 4 (e) and his minimum rate of wages shall be £8 15s. per week."

Clause 3—*Hours of Work.*

Subclause (c) was deleted and a new subclause will appear, 6 (j) reading:—

"If a worker is required to work for more than 4½ hours continuously, such worker shall be paid the appropriate overtime for the extra time worked until the meal period is allowed."

The following wage rates were agreed upon to operate from the 15th February:—

Designer, £10; Radio Technician, £9; Technician, £8 5s.; Radio Tester and Tester, £8 2s. 6d; Checker, £7 10s.; Assembler, £7 5s. 10d.; Radio Serviceman, £8 7s. 6d.; Unlicensed Serviceman, £7 10s.; Adult Female Assembler, £4 17s. 6d.

Junior male and female rates as in the New Zealand Metal Trades Employees' award.

Subclause (d) was extended by the addition of the words "with a minimum of 2s. on any day for dirty work."

Subclause (e) was amended by altering the words "factory manager" to read "foreman" and the rate increased to 4d.

A new provision was inserted under the heading of "Long Service Payments" and following the lines of the provision inserted in the partial settlement relating to Power Board linesmen and other workers. This provides for an additional payment of 1s. 8d. per week after five years' continuous service and 3s. 4d. per week after 10 years' continuous service with the same employer, unless the employer has in operation a scheme (which may include a superannuation scheme) which is not less favourable than the clause.

Subclause 3 of the Holidays Provision was amended to require three months' notice of annual holidays where practicable with a minimum notice period of 30 days.

Clause 11 relating to tools was amended by adding after the word "they" in the third line "at depreciation value."

The meal money provision was altered to 3s. in both places.

The second paragraph of clause 14 (b) was deleted and the following substituted:—

"Should, however, the employer and the worker agree that there is a necessity for the worker to use his own vehicle, then there shall be agreement with the employer and the union regarding the allowance payable for use of the same."

It was agreed that the Court's General Order should apply to the new rates and the expiry date.

Expiry date of the award is to be 30th May, 1952.

FOR SALE—In excellent condition, C.D.P., speed 78, disk recorder. Equipped output meter, scrolling, monitoring facilities. 15-ohm head. Recordings have been accepted for broadcasting. Price £48. Radio Traders, Box 194, Dannevirke.

DRY BATTERY SHORTAGE

When this journal was acquainted with the shortage position as mentioned in the Traders' Federation Notes, we took steps to inquire from the New Zealand source of supplies the position from their point of view, and the following statement is made by the National Carbon Pty., Ltd., Wellington.

The manufacturers of "Eveready" batteries in New Zealand offer the following information outlining the circumstances that have led up to the present temporary shortage of Australian manufactured "Mini-max" 45-volt portable radio batteries.

A substantial quantity of these batteries, sufficient to meet in full the immediate requirements of New Zealand, were shipped from Australia on the m.v. *Wanganella* on the 8th February. This consignment is still travelling back and forth across the Tasman awaiting unloading at this end.

The most recent New Zealand distribution of such batteries took place in January last when a consignment shipped per the s.s. *Monowai* was finally unloaded at Wellington after completing eight crossings of the Tasman.

At both Sydney and Wellington, wet weather interfered with loading and unloading. This coupled with waterfront disputes and other circumstances beyond the control of the manufacturer, has precluded the regular delivery of supplies, which would otherwise have been available for the New Zealand consumer.

Since America commenced the stockpiling of raw materials to meet a vast defence programme, Australian manufacturers have experienced certain delays in the deliveries of raw material shipments from the U.S.A. and Canada, the effect of this being to upset production schedules on some occasions. These experiences, of course, are by no means peculiar to portable radio batteries for many other manufactured items are today unobtainable or in short supply for this very same reason.

It is not a question of providing for such contingencies by manufacturing "Mini-Max" batteries locally for even if the necessary machinery was available for this purpose, it would not be economical to manufacture the comparatively small New Zealand requirements for a wide range of different sizes of this particular type of battery.

The "Eveready" factory in Australia has a production capacity sufficient to meet the total New Zealand demand without difficulty and it is believed that when normal shipping services are resumed between Australia and New Zealand, the full requirements of the New Zealand trade will be available again.

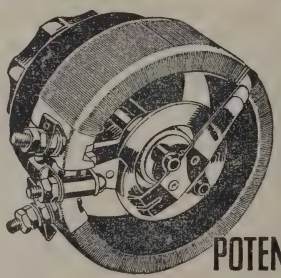
THE RAILWAYS KEEP THINGS MOVING

Forty Thousand Wagon-loads Each Week

As production increases, so does the demand for transportation, and with production at its present record peak the railways have a colossal job to do. Every hour of every day, an average of 240 railway wagons are loaded —forty thousand wagon-loads each week! To keep abreast of the demand, every wagon in commission has to work full time. Prompt loading and unloading, and clearance of wagons during week-ends if necessary, reduces the average turnround time and is of material assistance to all rail users.

Less Standstill Means More Wagons

CRESSALL



TOROIDAL WOUND POTENTIOMETERS

Cressall Toroidal Potentiometers are wound on a heat-resisting ceramic former and are produced in two types: R50 (50 watts) and R100 (100 watts), and also 4 and 6-watt units, both line and insulated spindle. The larger types can be supplied as double or trplie-ganged units with simultaneous drive. "Off" position types and slow-motion drive also available. Wide range of Toroidal Wire Wound Potentiometers held in stock; also resistance grids and sliding resistances. Made by the CRESSALL Manufacturing Co., Ltd., England.

Sole New Zealand Agents:

Bradley's Electrical Co., Ltd.

57A Victoria Street, Wellington

"Waveforms"

(Continued from Page 22.)

wave can only approach the theoretical ideal, and not actually reach it. Actually, much better wave-forms can be generated by this method, but in taking these photographs, they were purposely made worse than the circuit is capable of, in order to show just how a practical circuit's performance differs from the ideal. All that was done in this respect was to reduce the input voltage somewhat, so that the transitions would be slower, and more easily seen. For example, it can readily be observed that the sides of the wave are steepest in the centre, where the valve characteristic is steepest, and that the slope becomes somewhat less, appreciably before the extremes of voltage are reached. Examination will show that the positive flat portions are approached more gradually than the negative ones, indicating that the curvature of the characteristic near cut-off is more gradual than the curvature near the grid current point. A comparison between the input and output waves in the bottom photo shows that the negative half-cycle of output arises from the positive half-cycle of input, and vice versa—in short, a demonstration of the phase-reversing property of the amplifier valve. It is also possible to see that the positive flat portions are actually flatter than the negative ones. The former come from the valve being cut off, while the latter occur while grid current is passing. The slight rounding of the negative flat portions is due to the fact that the limiting action of the grid current is not perfect, so that the grid does go very slightly more positive at the peak of the input half-cycle. This illustrates very effectively the second reason for employing the grid stopper, R_s. It is that without this component, the bottom of the output wave would be anything but flat, owing to the fact that modern valves do not really have a saturation value of plate current at all. This is due to the oxide-coated cathodes that are used today. One feature of them that is not properly understood, even yet, is this very fact. As the grid voltage is made more and more positive, the plate current curve never quite flattens off, but continues to rise slowly. As a result, if the positive grid voltage were not limited by the grid stopper to a small value, the bottom of the wave would be quite rounded, and not "squared off" at all. Hence the use of the grid stopper. As well as protecting the grid from excessive current, it actually improves the output waveform. Even so, the flattest portion of the wave is the top, because once the valve is cut off, it can never be "more cut off," however negative the grid may go.

DIFFERENT TIME RATIOS

The circuit we have described is frequently used where the square wave required is wanted to have the positive and negative half-cycles almost equal in duration. It requires a low-impedance source (viz., the transformer secondary) if it is to act in just this way, however, and we will see why when we come to examine the next circuit, which is designed to produce a square-wave in which the positive and negative half-cycles are not of equal duration.

(To be Continued.)

NEW WAR SURPLUS BARGAINS

B.T.H. nine, fourteen, and sixteen cylinder Magnetos, ex aeroplanes
20/- Each

B.T.H. Fuel Pumps. Deliver 200 gals per hour at 2500 r.p.m. 20/- Each

Rotax Eclipse Aero Engine Starters.
20/- Each

Constant speed propeller controls.
20/- Each

Air pump, 8 cu. ft. perm in. at 1500
20/- Each

2 mfd. 200-volt Block Condensers.
Cat. No. Ex 1308 ..... 1/– Each

Ditto, 4 mfd.
Cat. No. Ex 1309 ..... 1/6 Each

D.P.D.T. push-to-talk or meter-push for intercommunication work. Depth 3 in. Width, $\frac{3}{4}$ in.
Cat. No. Ex 1021 ..... 2/- Each

Microphone Transformers. Ex Remote Control, suitable for Carbon Mikes to Dynamic Phones—suitable telephone kit.
Cat. No. Ex 1316 ..... 12/6

8 Feet of 2 in. x $\frac{1}{4}$ in. Leather Belting.
2 very heavy spring clips.
2 Buckles, 2 "D" Rings.
Good for wiremen's safety belts.
20/- Set

"THE LAMPHOUSE" 11 MANNERS STREET WELLINGTON

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. Advertising rates are charged according to space occupied. For further particulars contact Advertising Manager, R. and E., Box 22, Government Buildings, Wellington.

ELECTRICAL INSTRUMENT CO. TEST METERS

Swan Electric Co. advise they have now available two E.I.C. meters for rugged general purposes, and in the medium to low price field.

E.I.C. Universal Test Meter No. 3

Inclined dial 1000 ohms/volt, one knob control.

Ranges: Milliamps, D.C. 5-20-100-500; Volts, D.C., 1, 10, 100, 500, 1000; Volts, A.C., 10, 100, 500, 1000; self-contained resistance from .2 ohm to 2 megohm in three ranges. Millivolt range, 0–100 mV at 1 ma.; capacity, .001-2 microfarads.

Dimensions, 8 in. x 6½ in. x 4½ in. Scale, 5 in. Weight, 4½ lb.

E.I.C. UNIVERSAL TEST METER 5PB

Push Button Multirange Universal Test Meter. 1000 ohms per volt.

Effortless selection of ranges, ease in reading and exceptionally robust construction combined with perfect damping are outstanding features of this meter.

Ranges: Milliamps, D.C., 5-10-50,100-500; Volts, D.C., 10-100, 500-1000; Volts, A.C., 10-100-500-1000; Resistance, from 0.2 ohms to 2 megohms in three ranges, with self-contained battery.

10 megohm range with external 50 cycle 230/250 volt supply.

Capacity, .0001-.1 microfarad (press A.C. volts and capacity buttons). With 50 cycle A.C. mains supply.

* * *

PHILIPS FREQUENCY MODULATOR GM 2881

Application

The Philips frequency modulator GM 2881 is intended for making the resonance curve of radio sets visible on the screen of a cathode-ray oscillograph. This can be effected with the aid of Philips H.F. oscillators and cathode-ray oscillographs.

The instrument allows of a direct survey of the trimming conditions of high-frequency circuits and easy detection of deviations from the correct trimming.

Description

The frequency modulator contains a 4000 kc/sec. oscillator. With the help of the time-base signal delivered by the oscillograph, this frequency (f_1) can be varied between 3975 and 4025 kc/sec. *(i.e.,* frequency modulation of ± 25 kc/sec.). After mixing this signal with an appropriate external frequency, f_2, derived from the

H.F. oscillator, it is applied to the receiver to be tested. The frequency f_2 of the service oscillator must be adjusted in such a way that the difference between f_1 and f_2 is the frequency at which the radio set must be tested.

With the aid of the cathode-ray oscillograph, the resonance curve can be made visible both before and after detection (in the first case the signal applied to the oscillograph is a H.F. signal, in the second case it is a L.F. signal). The width of the image on the screen can be adjusted by means of a control on the frequency modulator.

The 4000 kc/sec. signal generated in the frequency modulator can be varied over ± 25 kc/sec.; the variation being read on a dial. By turning the knob out of the zero position clockwise or anti-clockwise, the curve on the screen is displaced to the left or to the right. In this way the bandwidth can be determined in a very simple manner.

The vertical amplitude of the diagram is proportional to the voltage produced by the set under test, and as the input voltage remains practically constant within one wave range simple sensitivity comparisons are possible.

TECHNICAL DATA

Oscillator frequency: 4000 kc/sec. ± 1.5 per cent. Range of bandwidth measurements: From —25 kc/sec. to +25 kc/sec. Frequency modulation: Up to about 35 kc/sec. Power supply: From the A.C. mains by a universal transformer, which can be switched for 110/125/145/200/220 and 245 V.; 40–100 c/sec. Mains consumption: About 20 W.

The instrument is light and portable and may be supplied with power from a Philips Vibraphil power supply (6V. D.C. to 220V. A.C.). where no A.C. mains supply exists.

Our Gossip Column

VISIT OF MR. C. O. STANLEY

Almost coincidental with the TV demonstrations was the visit to Wellington of Mr. C. O. Stanley, C.B.E., chairman and managing director of Pye, Ltd., Cambridge. Mr. Stanley was completing a tour of Australia and was commencing his brief tour of New Zealand when this journal interviewed him in Wellington, and it is only natural that he had a good deal to say about the possibilities of television in this country. In his opinion, there is no reason whty New Zealand should not have a TV station operating within a year to eighteen months of a decision to go ahead, at least in so far as the transmitting equipment was concerned, and expressed the opinion that a low-powered station such as would be needed to serve any one of our four main cities, would cost not more than £60,000, exclusive of buildings, studio facilities, and aerial towers. On the coverage problem, Mr. Stanley was optimistic about the results that would be obtained, and it is worth noting that he did not even consider Wellington to a poor locality topographically! Mr. Stanley, who had had discussions in England with the Minister of Broadcasting, Mr. F. W. Doidge, held further discussions with him while he was in Wellington, but it was hardly to be expected that any information on the scope of the talks was to be forthcoming!

Mr. C. O. Stanley

Mr. Stanley impressed all those who met him with his energy, his Irish humour, and his very great enthusiasm for television. During a press conference, it was particularly noticeable that he had all the answers to any actual or implied criticism of TV as a medium of entertainment. Some of his facts were distinctly novel, as for instance, his statement that the weather, combined with the fixed timing of many sporting events, virtually limited the period of the year during which outside broadcasst could be obtained in Britain, to two months. According to Mr. Stanley, TV operators in this country would be at a distinct advantage in that outside broadcasts of sports or other events of national interest could be televised during the greater portion of the year. It would give us an economical source of programme material of the best type, almost unrivalled anywhere where TV was operating at present.

On the cost of programming, Mr. Stanley had some very interesting observations to make. The most costly programme put on by the B.B.C. is the Sunday night play, he said, which is rehearsed and produced in a way comparing favourably with the best traditions of the stage. However, those who had not observed TV programmes as sent out day by day in an actual public service could not realize the type of programme material that was used a great deal. Much of it relied on the personalities of individual entertainers, who were able to "do their stuff" in a very satisfying manner with a minimum of props, sets, and rehearsal. Programmes of this nature, he said, were very popular, and cost almost no more to turn on than corresponding types of ordinary broadcast programmes.

One example cited by Mr. Stanley was that of the televising of a teller of stories, who simply sat at the camera very satifying manner with a minimum of props, sets, and rehearsal. Programmes of this nature, he said, were very popular, and cost almost no more to turn on than corresponding types of ordinary broadcast programmes. One example cited by Mr. Stanley was that of the televising of a tellor of stories, who simply sat at the camera as though he was one of the viewers' family party. The intimacy of such programmes cannot be achieved by any other medium, and their appeal was great, in spite of their low production cost.

Another point which Mr. Stanley was at some pains to bring out was the importance of television technique and knowledge as a stepping-off point for those who, in time of emergency, would have to become familiar with the specialized requirements of the many electronic weapons of war that are being developed. This point has been treated at length in a previous issue of this journal.

While enthusiasm for their subject is natural in those who are commercially interested in TV, Mr. Stanley's approach was notable for its sincerity and lack of what might be termed commercial "plugging." All those who had the pleasure of meeting him could not fail to be impressed with his grasp of the subject, and with the quiet authority of one who has clearly had more experience in the field than most will be able to gather.

* * *

The Management of Philips Electrical Industries of New Zealand, Limited, announces that Mr. Ralph Slade, hitherto Technical Manager, has now been appointed Commercial Manager of the Company.

Mr. R. Slade

Mr. Slade is well known in the radio industry and has taken an active part in its rapid development in New Zealand. Whilst in the Post and Telegraph Engineering Department he was one of that small band of radio amateurs who pioneered our modern long distance short-wave communication system. He resigned from the Post and Telegraph Department in 1929 to join Philips Electrical Industries of New Zealand, Ltd. (then Philips Lamps, Ltd.) and has contributed to this firm's rapid development ever since. During the war he was appointed by the Government as Controller of Radio Production and was responsible for the amazing war-time effort of the New Zealand radio industry. He is at present the Vice-President of the New Zealand Radio and Television Manufacturers' Federation.

* * *

On Wednesday, 28th February, the electrical trade paid a very fitting tribzute to Mr. J. M. Fleming at a cocktail party organized by the New Zealand Electrical Federation, at the Royal Oak Hotel, Wellington.

In his address to a very representative gathering, the Federation President, Mr. W. A. Simpson, referred to

the past services of Mr. Fleming to the electrical trade generally and to the N.Z. Electrical Federation, of which he was a foundation member and President for many years, and of which he is the first life member. On behalf of the electrical trade, Mr. Simpson presented Mr. Fleming with a beautiful crystal vase.

It will be of interest to our readers to learn that Mr. Fleming has been connected with the electrical and radio trade for the past forty-six years, firstly as secretary in 1905 and then Managing Director in 1916 of Turnbull and Jones Limited. This company's first venture into the radio trade was in 1922 when it dealt extensively for the amateur and constructor, importing components of a wide variety, besides marketing crystal sets and battery-operated receivers.

As will be known to all our readers who themselves have been long in the electrical and radio industries, Mr. Fleming has always adopted a policy of helpfulness and co-operation. Apart from the fact that under his guidance his company has always entered very fully into every movement for the general good of the trade, Mr. Fleming has never spared himself personally in fully participating in the work involved. In 1939 the Electrical Federation presented Mr. Fleming with an illuminated address and a silver service on behalf of all the electrical associations throughout New Zealand.

As evidence of his wider interests, he was for two years President of the New Zealand Employers' Federation, during which time he endeavoured to institute a co-ordinating council representative of all sections of industry to meet the problems common to all employers but, unfortunately, because of the conflicting interests involved, this movement did not bear fruit but, says Mr. Fleming, "I am of opinion that this must be achieved, as it is vitally necessary to employers as a whole."

Of a genial and friendly disposition, Mr. Fleming is familiarly known as 'J.M." While he remains Managing Director of his Company until the end of the present year, he has now taken up residence in Rotorua and all our readers will, we feel sure, join in wishing him many years of good health and enjoyment in his retirement.

* * *

Leaving shortly on an extensive visit to Great Britain and the Continent is Mr. J. N. Laird (Noel), of Hawera, whose interest in pioneering and developing the portable totalizators as used in New Zealand is well known. He will have as his main object a quest for the purchase of new totalizator equipment and the study of the latest principles and administration employed in Great Britain and Europe, and also to viewing in operation as many forms of totalization as time will permit.

Noel, who gives generously of his time to local body affairs, being a member of South Taranaki Electric Power Board and member of Patea Harbour Board and Chairman of Taranaki's largest primary school, hopes whilst Home to make contact overseas with some of those of kindred interests.

* * *

Mr. J. M. Griffiths, Hamilton Branch Manager, N.E. & E. Co.

Learning of the retirement on account of continued ill-health of "Griff" as he is popularly known in the Waikato we hasten to pay our tribute to him for his sterling qualities and friendly nature to all, whether customer or competitor. Those of the radio pioneering days will recall Griff and his experiences with "Fada" Radio and of his tours accompanied by Dave Wyles—famous for his lectures on "How It Works."

Joining National Electrical Company in its early formation Griff has now completed 45 years' unbroken service, and his retirement will be felt by many of his fellow staff and trade connections. All, however, will share with us the hope that retirement will restore him to better health and give him happy days for a long time.

* * *

Bradley's Electrical Company announce their appointment as New Zealand agents for A. J. William Electrical Instruments, Melbourne.

Alex Sternberg (Bradley's Electrical) has just completed a business trip of two months, visiting Sydney, Melbourne, Adelaide, and Tasmania.

* * *

Returning soon from an extensive tour of the United Kingdom and the Continent is Garnet Porter of National Electric and Engineering Co. He has included in his time away a working holiday, part of which was a course with B.I.C.C.

* * *

In keeping with their policy of periodically sending their engineers overseas for further enlightenment on latest developments in the engineering field, the National Electric and Engineering Co. is sending Mr. P. C. Watson to England where he will spend time with B.T.H. and other of the principals represented there by this company.

* * *

Jack Carpenter during March attended National Carbon Annual Sales Convention in Sydney.

ERSIN

"The finest cored solder in the world."

MULTICORE SOLDER

"THE GREEN CARTON"

18 S.W.G., 60 per cent. tin, 40 per cent. lead.

High quality radio solder.

Free Samples gladly supplied on request.

N.Z. Distributors:

GILES & ELLIOTT LTD.

9–11 BLAIR ST., WELLINGTON

Telephone: 54-695 Telegrams: "RADOGEN"

Influx of Radio Personnel to Wellington

Not for many years has so much been happening in the Radio World, in so small a space a time, as has happened during February and March, bringing with it large numbers of radio executives and traders from all parts of New Zealand. In February high executives representing employers' interests, met in conciliation council on employees' award claims, the results of which are printed elsewhere in this magazine.

* * *

A cocktail party by Green and Cooper in honour of a distinguished visitor from overseas, Mr. C. O. Stanley, held at Hotel Waterloo, brought together many traders and Government department heads and executives, all keenly interested in TV and V.H.F. projects.

* * *

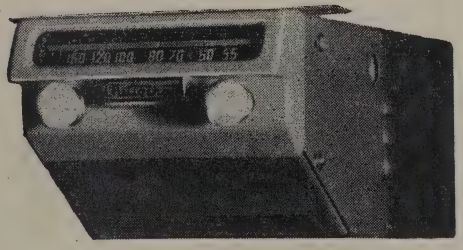
A.W.A. demonstrations of TV brought daily visitors to 2YA Studios for about ten days. At times the floor was literally covered with the throng of manufacturers and traders, etc., from Wellington and distant parts of New Zealand. Interest in this initial demonstration of TV was reminiscent of 25 years ago when the first broadcast receivers were on public view and several visitors during these TV demonstrations exchanged anecdotes of early days of radio.

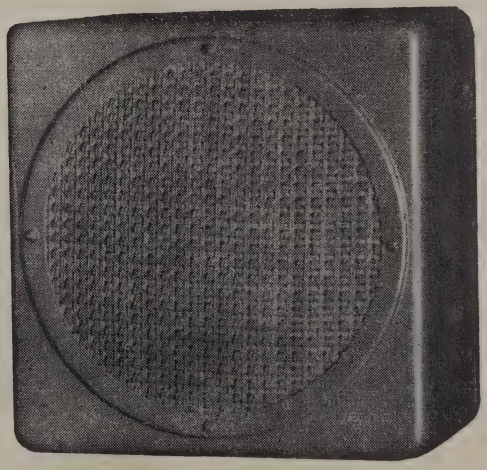
John Dunnett has just completed 40 years' service with H.M.V. (N.Z.) Ltd. A quiet function was held at the Head Office of that company when John was presented with a gift from the management for his long and loyal service, and his fellow employees gave him a radiogram as a mark of esteem.

SPECIALISTS IN A
SPECIALIZED FIELD.
MR. SERVICEMAN.
Our Universal Coils, types 40 (Aer), 45 (R.F.) and 41 (Osc) will replace any damaged R.F. Coil.
Inductance Specialists
THE N.Z. HIGH FREQUENCY SPECIALISTS
263 THORNDON QUAY, WELLINGTON, N.Z.
COILS, I.F. TRANSFORMERS, R.F. CHOKES, B.F.O.'s DIALS, SCALES, COIL ASSEMBLIES, GANGS, BUILT-UP UNITS, ETC.

"AUTOCRAT" CAR RADIO

BUILT TO WITHSTAND THE ROUGHEST CONDITIONS TO BE EXPERIENCED IN NEW ZEALAND





SIX-VALVE MODEL
Retail Price £34 9s.

Special and exclusive Autocrat features ensure perfect reception under the most adverse conditions. We stand confidently behind any demonstration a prospective buyer may require. Note these features: High-gain aerial circuit, latest metal type valves, low current drain—4½ amps. 6 volt or 2½ amps. 12 volt.

Manufacturers:

AUTOCRAT RADIO LTD.

PHONE 48-180 - - 118 VICTORIA STREET, AUCKLAND

Sole New Zealand Distributors: G. A. WOOLLER & CO., LTD., AUCKLAND.

VULCAN

Gramophone Springs

Inquiries are invited regarding indent orders for prompt delivery of Vulcan Gramophone Springs. Made by J. Stead and Co., Ltd., Sheffield, Vulcan Springs are made from spring steel of the very highest quality, specially treated to give added toughness with the best results, and are carefully tested for strength and uniformity. All sizes and types available, and every spring guaranteed.

GRAMOPHONE NEEDLES

Full range of "SONGSTER" Loud, Medium, Soft, and Long-playing Needles available ex stock.

Russell Import Co. Ltd.

20 BOND STREET, WELLINGTON

"CLEARLITE" for "Perspex" Products

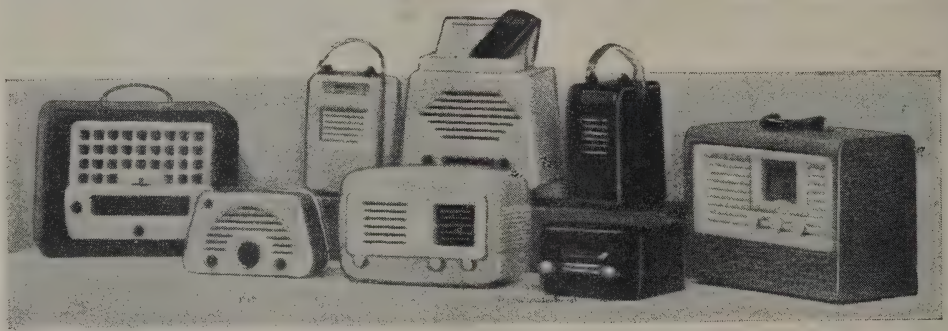


Illustration shows a selection of some of the radio cabinets produced by us for manufacturers

Consult with Clearlite Ltd. about design and construction of RADIO CABINETS, REFRIGERATOR CABINET COMPONENTS, LIGHTING FIXTURES, ADVERTISING SIGNS, DISPLAY FITTINGS, and all other industrial uses for which "Perspex" provides the only answer.

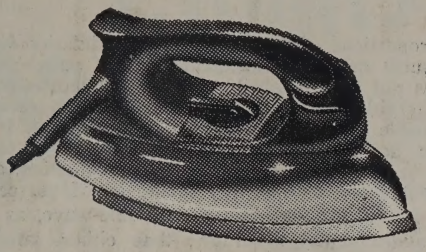
Clearlite Ltd. are now the leading manufacturers in New Zealand for all types of "Perspex" work.

Phone 18-206 for our representative to call.

CLEARLITE LTD.

PLASTIC FABRICATORS - 12 GREAT NORTH ROAD, AUCKLAND

ULTIMATE HEAT-CONTROLLED IRON



The Ultimate Electric Iron soon to be released is a lightweight high-quality iron which fulfils all the requirements of the utility appliance.

It has a highly polished soleplate of non-corroding alloy having 22 per cent. more ironing area, a button groove and a bevelled edge for the ironing of pleats, etc. The element is 1,000-watt copper-clad cast-in type which heats the iron uniformly from cold to maximum in 3½ minutes. Finger tip controlled thermostat is fool-proof in use and accurately calibrated.

The Ultimate Iron has a rubber flex guide and indicator light in the heel of its comfy-grip handle of beautiful moulded phenolic.

Specifications:

Weight: 3¾ lb.

Element: 1,000 watts at 230 volts.

CLASSIFIED ADVERTISEMENT.

FOR SALE.—One Z.C.1 Tranceiver complete with all accessories, including antenna, remote control units, etc. It has only just been taken out of its packing case. Covering 2–4 megs., it is ideal for amateur use. Offers. P. G. WILLIAMS, Managakuri, Otane, H.B.

BINDERS for

"RADIO and ELECTRONICS"

A limited number of binders are still available. If you have not sent your order, we urge your early action to avoid disappointment.

Prices are

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from

J. & C. LAIRD & SONS

"EDISWAN" TAPE RECORDERS and adequate supplies of tape are now in stock.

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STOCKISTS OF RADIO COMPONENTS FROM ALL LEADING NEW ZEALAND AND OVERSEAS MANUFACTURERS

RADIO, ELECTRICAL, AND SMALL-TOOLS SUPPLIERS

CODE "LAIRD," HAWERA • P.O. BOX 283 • TELEPHONE 522

R.F. Resistance Meter

(Continued from Page 29.)

the shunting of the meter by the adjusting resistor.

The additional H.T. control is exactly as shown in Fig. 3, with the addition of the voltmeter M_2. The series resistor has been left unmarked as to value, because this will depend on the meter movement used. It is simply a multiplier ressitance, arranged to make the meter M_2 read 0–5v. Please note that if any other scale is used, it will *not* be direct-reading, as explained above, and a small sum will have to be worked out every time a reading is made. It does not matter much what sort of meter movement is used, as long as it is a good one. A 1 ma. meter, of good make would be quite satisfactory, but there would be no harm in using a less sensitive meter, as long as its readings are accurate. In our case a war surplus 0–500 μamp movement was used, with very satisfactory results, so that in this case the multiplier required was 10k., less the 500-ohm resistance of the meter itself, giving a multiplier of 9500 ohms.

(To be continued.)

Philips Experimenter

tive proportions of driver and final modulation will serve to acquire the most linear modulation pattern possible. It does not matter which type of modulation pattern is used, as either the envelope type or the trapezoidal type will enable the same answer to be arrived at. It is preferable, however, to have a steady source of tone with which to perform the experimental modulation, although it is not essential that this should be of perfect waveform. If the tone used is a pure sine-wave, as from a good audio signal generator, then either pattern may be used equally well. If, however, a distorted sine-wave is used—and such a thing can easily be "lashed up" in a hurry for the purpose—it will be necessary to use the trapezoidal kind of pattern, since this is not affected by the purity of the waveform. The main thing is that the tone should be steady, rather than intermittent, as speech is, so that a steady and easily interpreted pattern will result.

Emidisc

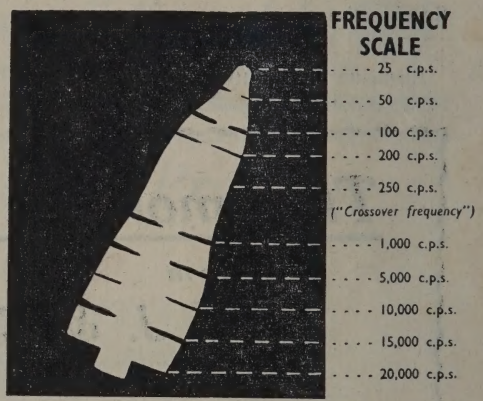
TRADE MARK

LACQUER RECORDING BLANKS

The "Emidisc" lacquer recording blank fulfils the requirements of the most exacting standards of Broadcasting Authorities, Film and Professional Recording Studios. It may be used with confidence by the critical professional recording engineer and by the owner of the most modest equipment.

Accurate engraving to the limits of the recording equipment is ensured by these essential qualities and characteristics.

- SUPERIOR UPPER FREQUENCY RESPONSE. Will record up to 20,000 c.p.s. with appropriate recording equipment.
- LOW NOISE LEVEL. Average figures: —45 db. ref. level 1 cm. per sec. velocity; — 63 db. ref. level 8 cm. per sec. velocity. (Cut at 78 r.p.m., 9½ in. diameter using sapphire cutter with 16 micron bevel.)
- ANTI-STATIC. Easy swarf clearance with brush or low-power suction systems.
- LACQUER THICKNESS constant over whole recording area.



Buchmann & Meyer pattern of a gliding tone, 20 Kilocycles to 25 cycles recorded by E.M.I. Studios Ltd., on an Emidisc blank.

- GOOD WEARING QUALITIES.
- PROCESSING: Mirror-like surface ensures ideal condition for processing (on appropriate sizes of blanks).
- PACKED IN HERMETICALLY-SEALED METAL CONTAINERS. Ensures good shelf life and protection. 10 in. sizes and upwards have individual air separation of blanks.

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Types and sizes available for all purposes.

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TRADE-MARK

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C: 3744—Ideal, all-purpose flashlight; 3-cell; focusing.

D: 3745—Big, powerful, out-of-doors searchlight model; 5-cell; focusing; 3½ in. reflector.

E: 2247—"EVEREADY" Gaslighter; perfect for gas-ovens, coppers, etc.; simple button switch; extra long stem with replaceable tip; special type long-life battery.

F: 3773—Standard 2-cell focusing flashlight.

G: 3763—Convenient 2-cell pocket-size model.

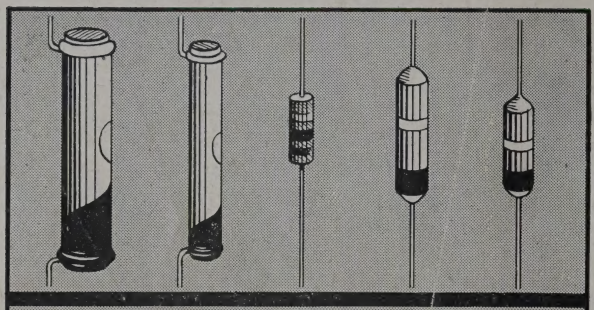
H: 2545—Small, streamlined, two-cell flashlight; excellent for ladies' handbags. In four colours; unbreakable glass.

NATIONAL CARBON Products

ER50/F18

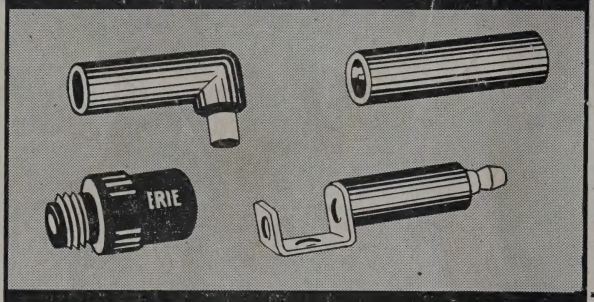
ERIE

Electronic Component Products



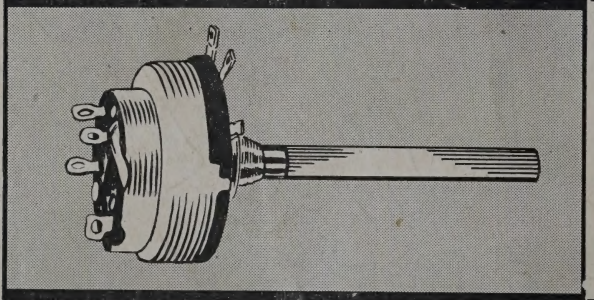
CARBON RESISTORS

Erie Resistors are the finest offering on the New Zealand market. Constant research has not only improved their electrical characteristics but has resulted in the development of new, *smaller* units and insulated types that meet the urgent demand for efficient performance in restricted space under severe operating conditions.



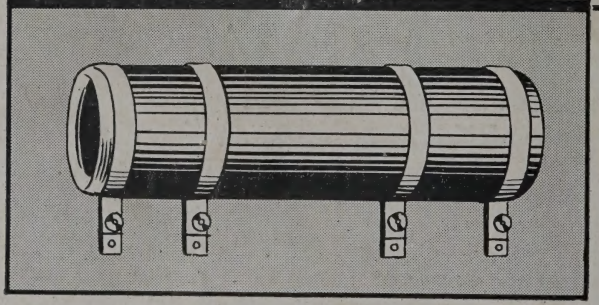
SUPPRESSORS

Erie Suppressor Resistors are designed for the suppression of high-tension interference caused by the ignition system of internal combustion engines without detracting from the performance of the engine. Available in four different types sufficiently diverse to fit any known make of car.



POTENTIOMETERS

Erie Potentiometers are of the carbon track type and embody a carbon-sprayed bakelite element with a maximum overall dissipation of one watt, and are available in values from 2,000 ohms to 2 megohms inclusive, either with or without switches, which are of the S.P. Single Throw and D.P. Double Throw types only.



VITREOUS ENAMELLED WIRE-WOUND RESISTORS

Erie Silicone-finish Wire-wound Resistors are wound on a high-grade ceramic former which will withstand considerable thermal shock without disintegration. Windings are spot-welded to flexible copper nickel or nickel chrome wires brought out in the form of pigtails tinned with hot solder or connected to nickel silver bands according to individual preference. Maximum rating is 100 watts, maximum size 63/16 in. x 11/8 dia., maximum resistance 50,000 ohms, and within these limits all resistors are made to individual requirements.

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